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AUTHOR Chauliac, Michel; And Others
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ABSTRACT

Described in this issue of "Children in the Tropics" are handicraft, semi-industrial, and industrial projects which produce weaning foods in developing countries. The introductory section briefly discusses the global epidemiology of malnutrition and offers guidelines for combatting malnutrition. Chapter I provides a framework for reflection on the establishment of a workshop for the production of a weaning food, and discusses the decision to produce such food at a semi-handicraft level as part of an effort to be a self-financing, independent component of economic development. Chapter II discusses the production of weaning foods at the Ouando Gardening and Nutrition Centre in the People's Republic of Benin. Particular attention is given to ingredients, functioning of the workshop, distribution, promotion, economic aspects, nutritive values, and how families react to the product. Chapter III discusses the MISOLA weaning food experiment in Burkina Faso. The early period of production, evolution and assessment of production, and integration of MISOLA into nutrition education are discussed. Chapter IV describes the production of a porridge, Likuni Phala, in Malawi, a country that is, paradoxically, an agricultural exporter having difficulties meeting the nutritional needs of its citizens. Chapter V discusses the local production of weaning foods in Africa. (RH)

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1987 N° 167-168 WEANING FOODS

in the TROPICS

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ICC soon turned essentially toward Third World children and devoted its activities to the training and education of personnel with social, educational and administrative responsibilities as well as medical and paramedical workers. The desire for greater efficiency has led it to work increasingly with trainers and to concentrate its efforts on the methodological and educational aspects of mother and child care programmes.

ICC is also engaged in an attempt to further study — and — action on some aspects of the life and health of children and their family, so as to contribute to practical improvement, particularly in the fields of growth, nutrition, planned parenthood, the control of transmissible and nutritional diseases, preschool and school education, the needs of disabled and underprivileged children, etc.

Over this period of more than 30 years, a large amount of documents on children and adolescents, mostly from the developing countries, has been accumulated. This international documentation has been classified and sorted out, and has been computerized since 1983 : a bibliographic data base (BIRD : "Base d'Informations Robert Debré") may be consulted anywhere in the world, through international communications networks. ICC also publishes periodicals, educational documents and specialized bibliographic bulletins.

As for its legal status, the International Children's Centre is a foundation under french law of recognized public utility, administered by an executive board with broad international membership.

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EDITORIAL

by Anne-Marie MASSE-RAIMBAULT*

In the last two decades, many attempts have been made to produce weaning foods in developing countries. The first such products were manufactured industrially; they include INCAPARINA in Latin America and SUPERAMINE in Algeria. At that time, national and international food policies tended to incriminate protein deficiency in most infantile nutritional pathology. Nutritionists have recently discovered this to be untrue, and have placed increasing emphasis on calory intake. Officials then thought that locally produced weaning foods made of local foods would be the solution for saving malnourished children. As a result, these foods were frequently viewed as medicinal, mostly aimed at the severely underprivileged strata, which are indeed those most affected by this pathology. It was an easy step from this view to a popular assimilation of weaning foods with "food for the poor and the sick". In the industrialized countries, infant foods are viewed as food for healthy children, and which helps them to remain healthy.

Despite their high cost, the large-scale experiences, often of the national and industrial type, did not meet expectations, since the role to be filled by these foods had not always been clearly defined: were they a complement to breast milk for children over a given age? Should they supplement other foods already eaten by the small child, or should they alone cover all nutritional requirements? Are they aimed at all children, or only at the poorest, the undernourished? These choices necessarily influence decisions at the various phases of production, and more crucially, the information and nutrition education given to families and health workers, and the promotion of the product.

Furthermore, planning of the different phases of production was insufficient, and poorly adapted to local resources, so that difficulties were encountered at the production level (uneven, insufficient supply, contamination of the plant, requiring stoppage), as well as in plant maintenance, commercialization and distribution.

Another cause of failure was the lack of participation of health workers (nurses, paediatricians and physicians, particularly those in private practice), who continued to prescribe imported foods, and therefore participated, sometimes unwittingly, in giving a poor image of the local food, which then became a food for the poor and the sick.

Later, we witnessed the proliferation of small-scale, hand or semi-industrially made weaning foods, produced for people living in a smaller area, using techniques which were more of the nature of those commonly used locally.

This issue of our journal presents some of these projects. The MISOLA experience in Burkina Faso is on a handicraft level, while the Ouando one in Benin might be called a semi-industrial one, since it uses a relatively sophisticated technology and produces large amounts of weaning food. Last, the "LIKUNI PHALA" experience in Malawi is more of the industrial type.

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* Physician ICC.

The WHO Regional office in Brazzaville has analysed small-scale family and village-level projects implemented in that area. This provides an overview of the various African experiences, showing that what counts in the integration of the project in the home context, and family involvement in setting it up.

We have emphasized several important points. If we are to improve the diet of weaning-age children, and to eliminate-protein-energy deficiency, it is not enough just to mix up several local foods and to provide a weaning food recipe. The introduction of a weaning food is a part of a general nutrition policy applied at a national and regional level, and requires an analysis of the situation, with special emphasis on parental dietary attitudes with respect to their children, nutritional status, working women and local resources. All phases of production must be planned and tested on a small scale, and the advertising, family information and education and personnel training aspects should not be neglected. All projects of this type involve a number of sectors, often including those which touch upon foreign commerce and the legislation.

In our opinion, production of weaning foods should safeguard national independence whenever possible: using milk as an ingredient in a weaning food when the country does not produce any runs the risk of having to interrupt production.

Present experience shows that small-scale production units have a greater chance of success in many countries: there is less need to transport the ingredients and the final product, the risk of contamination is lower, the composition of the weaning food is more appropriate to the local diet, work may be provided for women, etc.

INTRODUCTION

By Michel CHAULIAC *

1. GLOBAL EPIDEMIOLOGY OF MALNUTRITION

Given the number of individuals affected, the effects on mortality, morbidity, work productivity and the ability of children to develop according to their experience and education, malnutrition constitutes one of it not **the** major Public Health problem throughout the world.

Although protein-energy malnutrition is present in the developed countries, and is generally linked with various severe pathological conditions (such as malignant tumours, liver and gastrointestinal diseases, anorexia nervosa, senility, etc.), it mostly affects children in the developing countries, and above all those under 5 years old, pregnant and lactating women and, to a lesser extent, women of child-bearing age.

Children suffering from the well-known clinical forms (kwashiorkor and marasmus), represent only a tiny minority of the malnourished, who languish in a state of latent or moderate malnutrition.

Despite considerable efforts, development projects, health and nutrition policies and programmes and various dietary aids, the percentage of malnourished children under 5 has stagnated over the past two decades. Their absolute number has increased: taking a weight/age ratio over 2 Standard deviations (1) below the NCHS (2) reference median as an indicator of protein-energy malnutrition, WHO (the World Health Organization) estimates the number of under nourished children under 5 years old in the developing countries at 125.9 million, or 42.7% of that age group, during the 1963-1973 period. The figures for the 1973-1983 decade were 145.4 million, or 42.3% (3).

Such overall estimations are based on an anthropometric indicator which does not distinguish acute malnutrition from chronic malnutrition. As shown in table 1 and figures 1-2-3, they mask great disparities between different regions, countries, age groups, types of population groups (rural, suburban, urban, privileged or underprivileged, literate or illiterate...) and forms of protein-energy malnutrition.

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* Physian, ICC.

(1) For the definition of a standard deviation, see CIT n° 160-161.
(2) NCHS: National Center for Health Statistics.

(3) Nutritional Surveillance. Global Trends in Protein-energy Malnutrition Prevalence. WHO, Weekly Epidemiological Records, 1984.59; p. 189-192.

TABLE 1

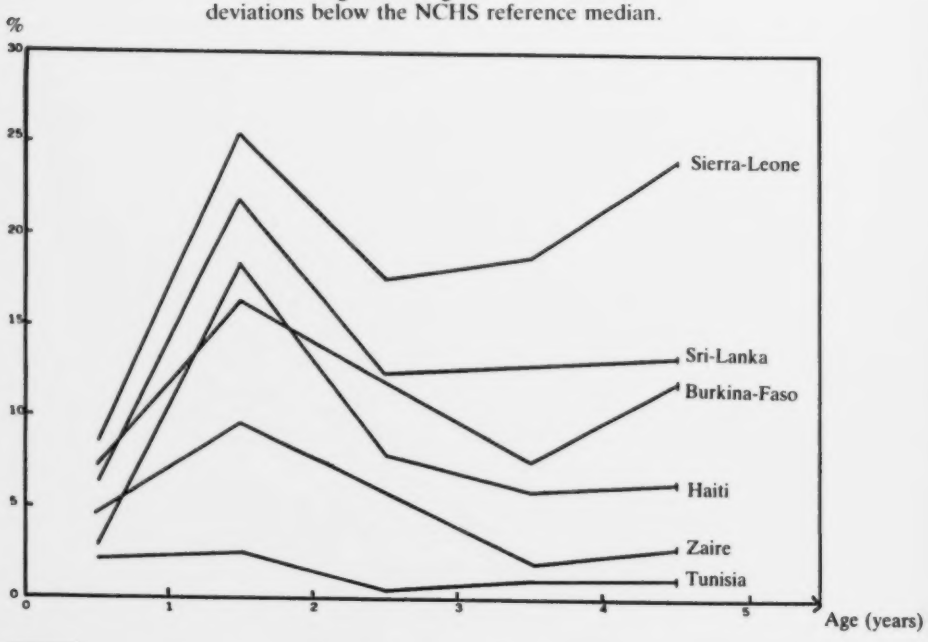
Prevalence of Protein-energy Malnutrition among children under 5 in various developing regions (weight/age ratio over 2 standard deviations below the NCHS reference median.)

Region	%	Number (millions)
America	17.7	8.6
Africa	25.6	21.9
Asia	54	114.6
South Sea Islands	11.5	0.3

Taken from: WHO, Weekly Epidemiological Report N° 25, June 22, 1984.

FIGURE 1 (1)

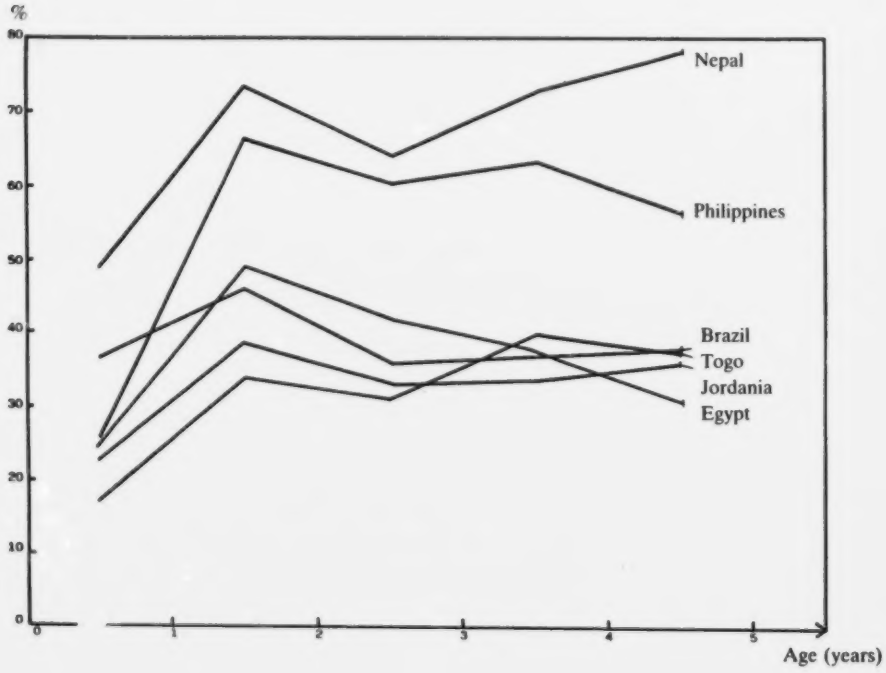
Percentage of children in different age groups with a weight for height over 2 standard deviations below the NCHS reference median.



(1) Taken from W. Keller and C.M. Fillmore, Prevalence of Protein-Energy Malnutrition, Wld Hlth Statist. Quart. 36 (1983) p. 129-167.

FIGURE 2 (1)

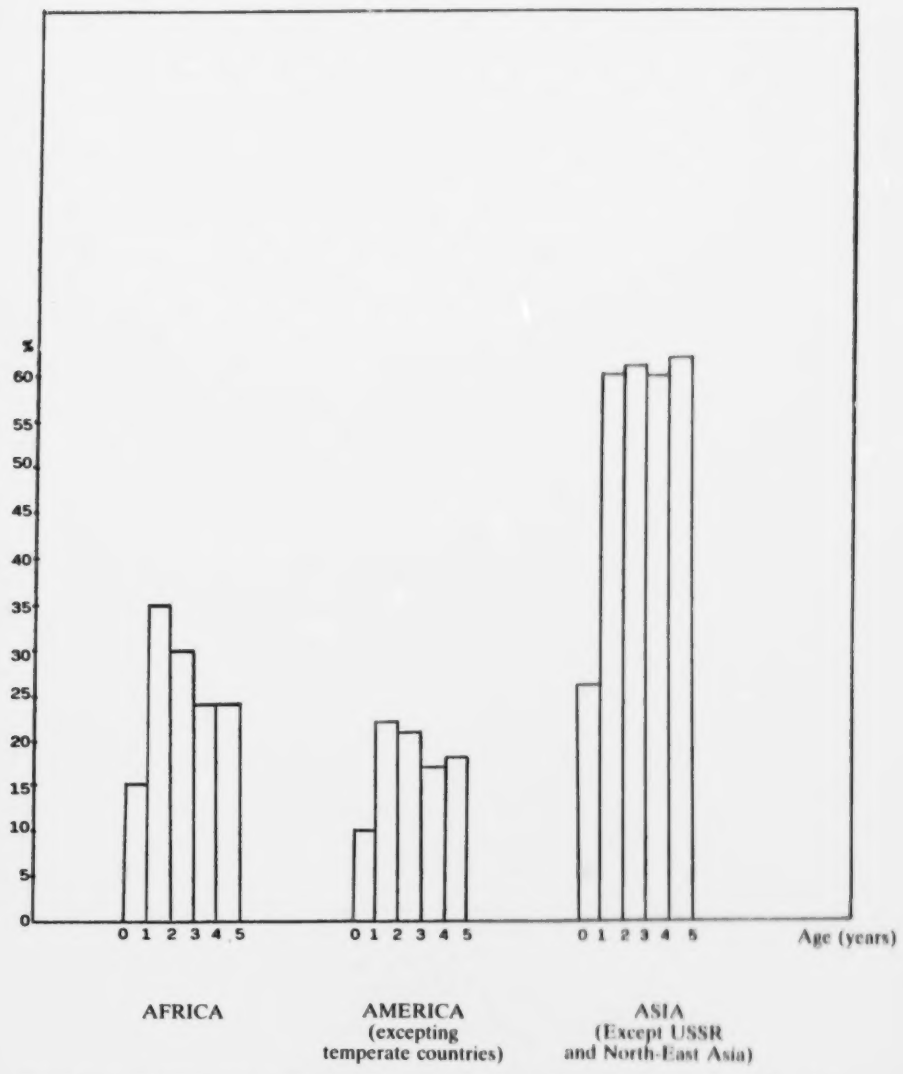
Percentage of children in different age groups with a height for age over 2 standard deviations below the NCHS reference median.



(1) Taken from W. Keller and C.M. Fillmore, Prevalence of Protein-Energy Malnutrition, Wld Hlth Statist. Quart. 36 (1983) p. 129-167.

FIGURE 3

Prevalence of protein-energy malnutrition in different age groups
and in different parts of the world
(weight for age over 2 standard deviations below the NCHS reference median).



Taken from: Nutritional Surveillance. Global trends in protein energy malnutrition. Prevalence - WHO. Weekly epidemiological, 1984, 59 p. 189-192.

Although there is now a trend, in several countries, and more specifically in poor urban areas, towards very early occurrence of PEM (Protein-Energy Malnutrition), owing to the use of breast milk substitutes and the practice of feeding infants foods with no nutritional value (foods that fill the stomach and appease hunger without providing the needed calories and nutrients), the percentage of children with protein-energy malnutrition generally rises suddenly between the ages of 6 and 18 months. This corresponds to the weaning period, which is the time when the child gradually shifts from a diet of breast milk (recommended as the only food until age 4-6 months, unless the mother is severely undernourished) to an adult type diet. Weaning is completed when breast feeding is completely discontinued.

In most cases, children catch up on their weight betwen the ages of 18 and 30 months, and maintain this situation until age 5. But height often lags behind, and shortness, indicating chronic malnutrition, is still quite frequent at age 5 or even later.

Children are not the only ones to suffer from protein-energy malnutrition: when pregnant women do not eat properly they do not gain enough weight during their pregnancy, and this may affect their baby's birth weight and decrease the amount of milk secreted during breastfeeding. This is particularly true when their nutritional status was already poor before their pregnancy. School-age children, adolescents and adults may also suffer from protein-energy malnutrition during pre-harvest periods, when little food is available, and during natural catastrophes (drought, floods, earthquakes, etc.).

Various other types of nutritional deficiencies may exist, in addition to the form of malnutrition represented by an overall insufficient dietary intake of energy and/or protein. They occasionaly occur in limited geographic areas, and are more or less linked with protein-energy malnutrition. The most frequent types are iron deficiency, producing anaemia (see CIT n° 133), vitamin A deficiency, which leads to xerophthalmia (see CIT n° 165) and iodine deficiency, which causes endemic goiter (to be discussed in a forthcoming issue of CIT).

These deficiency diseases also begin during the weaning period, and sometimes even during intrauterine life. Descriptive epidemiological findings show that 6 to 24 month-old children constitute a particularly vulnerable group, from the nutrition viewpoint.

2. HOW TO COMBAT MALNUTRITION

The numerous policies, projects and programmes established and implemented in order to combat malnutrition have demonstrated the complexity of the problem, for which there is no universal solution. A multitude of sectors must be taken into consideration. They deal with health, population, economics, agriculture, regional equipment and education.

Each programme envisioned should take into consideration the specific cultural aspects of the people at which it is aimed as well as the existing social relations. Psychological and sociological factors play an important role in eating habits and behaviour with respect to health and disease. No isolated action can result in a significant, lasting improvement of the infantile and general nutritional status.

When the specific dietary and nutritional situation of an area has been analysed, the activities planned will be appropriate to the population's most urgent needs, to its concerns and ability to participate, to the quantitative and qualitative scientific data collected within that community and then interpreted, to the guidelines defined at the national level, and to the human, material and financial resources available. This issue of our journal does not aim at analysing the various existing undertakings with respect to their pertinence, efficiency, their cost/efficiency ratio and their short and long-range impact. We do wish, in various combinations and in a proper context, may improve the nutritional situation:

- health check-ups
- treatment and prevention of diseases
- longitudinal surveillance of growth
- the study of dietary behaviour
- increased food availability
- redistribution of the national wealth
- education
- training of qualified personnel
- dietary supplementation
- food enrichment
- information and education on food
- production of weaning foods
- setting up of efficient structures

Regular check-ups of the health of mothers and children by competent personnel is essential, as is the implementation of specific curative and preventive activities: early detection of infectious diseases, immunization, treatment, visits to homes so as to observe, talk with and advise mothers, taking their difficulties into consideration...

The collection and analysis of longitudinal data enables us to know and follow up the nutritional status of individuals, of the population as a whole and broken up into various groups: age groups, living areas, ethnic origin, socio-economic level, use of health services, etc. This type of activity, for which the health sector is responsible, is most valuable in defining thoise individuals and groups to which action should be directed as a priority (adolescent girls living in underprivileged urban areas, for instance...). It also is necessary for an evaluation of the impact of the programme and to provide material for a constructive dialogue with the other sectors.

When administrative teams and structures, coordinated from the village or neighbourhood level to the highest level, are set up and work in a flexible manner, avoiding a heavy bureaucracy, they are useful for following the evolution of the dietary and nutritional situation, and make it possible to define applicable decisions, making for some local autonomy.

The analysis of people's dietary habits, particularly with respect to child-feeding practices during the first 2 or 3 years of life should not be reduced to a simple description. An effort should be made to determine cultural, social and economic reasons, so as to understand the community's attachment to certain foods, its knowledge of food combinations and types of food preparation, why children are introduced to certain foods at a given age or phase of development, and vice versa, adult attitudes toward the feeding of sick children, the problems encountered in obtaining food products and preparing dishes, etc. In some situations, for instance, a special porridge will not be prepared for children, to avoid showing how special they are felt to be, solid foods will only be given when the child has teeth, children will not be fed vegetables because they are only fit for animals, certain

food mixtures believed to be unhealthy will not be given, etc. Such analyses should include difficulties faced by women: their work, particularly during the period of heavy farm work in rural areas, the fuel problem, work outside the home, etc.

Increasing the availability of food requires the participation of the planning, agricultural, economic, transportation, commerce, market organization and environment protection sectors at the local, regional and national levels. This is a field which far exceeds the competencies of health officials, but on which they should be consulted, in order to determine which food products should be emphasized, and which groups should be the targets of producer or consumer-aimed incitement measures.

Redistribution of the national wealth and increased income for the underprivileged classes, generally situated in rural and peri-urban areas require that these people be given access to land, funds, appropriate technology and employment.

Literacy and education for both boys and girls and adults contributes greatly to improving diet. In many countries it has been proved that, for a given socio-economic level, children whose parents, and particularly, whose mother have been to school have a better nutritional status than those whose mother is illiterate. Education enables people to express their needs more clearly, to adjust to different situations, and to be relatively independent with respect to traditional authority and to the health and dietary practices connected, with them.

Training of health personnel should include scientific knowledge, as well as an understanding of the importance of observation, proper reception of people, attitudes towards individuals and communities, the information and education of administrators and rural development workers, planning, and the role of families in nutrition and diet.

Global supplementaion programmes of various types have been launched: "Food for work" programmes set up by the World Food Programme (WFP), supplements for all families for some families, for certain individuals selected on the basis of pertinent risk criteria, supplements eaten on-the-spot or take-aways, etc. Evaluation of the impact of such programmes should examine their effects on the economic activity of the region as well as the improvement of nutritional status.

Specific medicinal supplementation to combat deficiency in one nutrient (vitamin A, iodated oil, iron, folates) have also been attempted, as well as the enrichment of food staples with iodine (salt), vitamin A (sugar, milk products), vitamin D (milk products, special baby foods), iron (salt, flour, infant foods).

The production of weaning foods at a local level is therefore one of the many activities which may improve the nutrition situation.

I. SEMI-HAND CRAFTED PRODUCTION OF WEANING FOODS: FROM THE PRODUCER TO THE CONSUMER

By Michel CHAULIAC

The general remarks presented in this chapter provide a framework for reflexion on the establishment of a work-shop producing a weaning food. Each situation requires a specific analysis, for which pertinent questions must be put as to the socio-cultural, economic and health particularities of the region, its population, and the families of which it is composed. What is discussed here is the decision to produce such food at a semi-hand craft level, in an effort at self-financing and an independent workshop, constituting a contribution to economic development. We presuppose that such production has been identified as an element of a policy aimed at the improvement of infant nutritional status.

1. GENERAL RULES

The main objective of a weaning food is to contribute to the improvement of nutritional status during the weaning period and to the prevention of infant malnutrition in the region in which it is distributed.

To achieve this, a number of conditions must be met. The weaning food must be:

- sufficiently nutritious to cover the requirements of children of that age, with the possible help of other, traditional foods;
- of a satisfactory microbiological quality, considering the way it is prepared in homes;
- appropriate to infants' digestive abilities;
- cheap enough to be purchased by all families, including the poorest;
- acceptable, meaning that the taste, colour, odour and texture are appreciated by the population;
- available, always in supply, close to living quarters;
- used by families in appropriate amounts and with respect of proper hygiene;
- seen as an ordinary food, more specially for children, and not as a supplement;
- eaten regularly;
- known and appreciated by health workers, who should participate in popularizing it ;

These conditions imply:

- that the ingredients correspond to the most urgent nutritional problems, the final product is appreciated by families and children and is easy to digest;
- production costs are reduced to a minimum;
- the certainty that raw materials will be supplied regularly;
- mastery of the technology used, particularly with respect to machine maintenance;
- surveillance of sanitation during processing, and of product quality;
- a flexible, inexpensive, regular, controlled distribution system;
- proper administrative and financial management of the work-shop, involving the ongoing evaluation of costs, stocks, demand, sales and consumer opinions;
- promoting the use of this food, informing families completely about how to prepare and use it;
- informing health workers of its nutritive value, the target children, how to use it, what advice to give families when recommending it;
- selling the food rather than giving it away. It is a local commercial product and may be sold both at markets and in shops and health centres;
- periodical evaluation of the various stages of the food chain, extending from the production of raw materials to the impact of the weaning food on children's health.

The production of a weaning food, using local produce, contributes to regional development by:

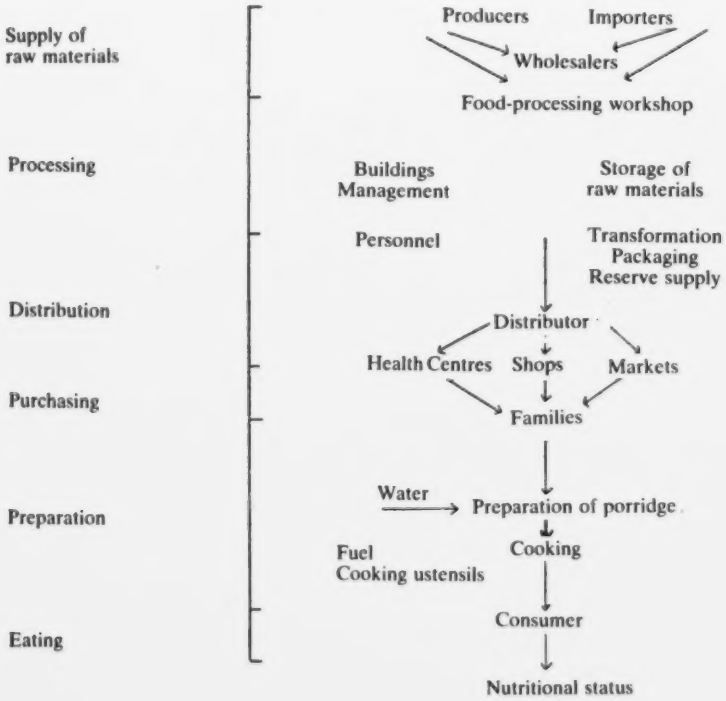
- stimulating food production, since farmers are assured of a regular market for their crops;
- creating business, since dealers may make a small profit on it;
- reducing costly importation of weaning foods produced in the developed countries and of raw materials not produced locally, thus reducing the subsequent currency outflow;
- creating jobs in the workshop;
- reducing the work load of women, who prepare the porridge;
- improving children's nutritional status, and therefore decreasing mortality and morbidity and laying the ground for better psychomotor development;
- increasing people's awareness of the ability of independent local action to improve children's health status.

2. EXAMINING EACH STEP

Figure 4 shows all of the steps on the food chain of a weaning food, from its production to its consumption. Before production is begun, each of these steps must be analysed thoroughly at the local level, so as to discover any possible obstacles and to examine the most appropriate solutions. Once production has begun, periodical evaluation should indicate any points requiring improvement; appropriate responses may then be envisioned.

FIGURE 4

Steps on the food chain leading to a weaning food



This chapter lists the main questions to be answered before this type of activity is implemented.

- What is the demographic situation? The population density? How many children are aged 6 months to 2 years? How many children per family?
- What is the nutrition situation of mothers, infants, children being weaned and those under 5? Do specific deficiencies in iron, vitamin A or iodine exist in children? Are they extremely rare or quite frequent?
- Are there already some weaning foods on the market?
- Where do they come from? Who produces them? What is their nutritive value? Their cost? Who buys them? Who eats them?
- What are the local weaning practices? Until what age is breast feeding continued? At what age are food complements introduced? What foods are then used? Where do families purchase infant foods?
- Is there a need for the type of weaning food planned? By whom is it expressed: the population, manufacturers, the health services...?
- What are the individual food preferences?
- What is the level of family income? How much is spent for feeding children? In rural areas, urban areas?
- How is information on diet transmitted? What do health workers advise with respect to weaning?
- What are the main regional food productions? What do they cost? Is production stable? What is their nutritive value? Can they be ground to flour?
- How can the initial infrastructure be financed?

This first analysis will pave the way to production, and make it possible to define.

- what local food products best fulfill the nutritional requirements of the children in the region, and to people's tastes?
- which families are likely to buy the weaning food? where are they located?
- where should the workshop be set up in order to minimize problems of raw material availability and of distribution?
- what should be the maximum purchasing price for the food?
- what distribution and promotion system should be considered?

A. Ingredients and nutritive value

Once these preliminaries have been dealt with, the next question is the exact composition of the weaning food. No single food (given along with breast milk) is capable of satisfying all of the infant's nutritional needs during the weaning period. Cereals or roots, which are traditional weaning foods in many places, are rich in carbohydrates but relatively poor in proteins, and also lack various minerals and vitamins. The amount of energy and

nutrients provided by these foods at each meal, is to small to cover requirements, given the small capacity of these children's stomach.

There are two possibilities, as far as nutritive value is concerned. The question is:

- should the weaning food, given in addition to breast milk, suffice in itself to cover infants' nutritional requirements?
- should the weaning food represent a necessary complement to a diet composed of breast milk and other foods?

The second solution is generally preferable, since many vitamins are destroyed by heat, oxidation and light. In addition, children should gradually be introduced to a varied, adult-type diet.

The ingredients chosen should represent the best possible compromise between a number of factors: what local produce is available and easily supplied, difficulties in processing, cost, nutritive value, acceptability of the final product.

Whether or not imported ingredients (such as powdered milk and/or vitamin and mineral supplements) are introduced will depend on:

- children's nutritional status during the weaning period;
- their present and foreseeable cost;
- whether a steady supply is ensured;
- the ensuing technological constraints;
- their acceptability;
- the social and economic impact on the nation: outflow of foreign currency, lack of stimulation of local industry, loss of income for producers, reinforcement of the image of a country dependent upon others.

Products requiring cooking are preferable: they are cheaper to produce, and require that water be boiled, thus limiting the risk of gastrointestinal infection for the child

The nutritive value of the food mixtures considered should be calculated using the tables of food composition (1), taking into account the digestibility and essential amino acid content of proteins, the risk of deterioration of vitamins during processing, storage and cooking, the bio-availability (2) of minerals and trace elements and, possibly, their relative amounts.

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(1) The nutritive qualities of the different foods have been discussed in issue 147-148 of Children in the Tropics.
(2) The proportion of the nutrient which is actually absorbed by the intestinal mucosa.

Attention should also be paid to the influence of antinutritional factors (trypsin inhibitors, haemagglutinin in soya, aflatoxin, etc.) (1). If there is no simple, effective, reliable and controllable way of destroying them, the ingredient responsible for the risk should be eliminated from the weaning food mixture.

When the optimum composition has been defined:

- its acceptability should be tested on a small sample of families, in order to determine whether consumers find the product satisfactory. If the test is conclusive,
- a laboratory analysis is made of the nutritive value of the product, of obtain accurate data. Food composition tables indicate average nutritive values, and there may be slight variations in raw materials. Processing (and particularly the heating of some ingredients during crushing and grinding) may also modify the nutritive value of the final product.

Decisions have then been reached as to:

- the composition of the weaning food and its nutritive value;

The next decisions involve:

- the location of the workshop
- those producers and wholesalers from whom ingredients will be purchased
- possibilities of distribution
- the target group.

B. Production

Production of the weaning food involves many operations affecting the different ingredients. These include: storage of raw materials, processing of the food, which generally involves sorting, washing, drying, toasting, crushing, grinding, cooling, weighing and packaging, after which the final product must be stored.

A satisfactory level of building, tool and worker hygiene should prevail, compatible with the proper bacteriological quality of the final product. For this reason cleanliness is a top priority and should be strictly enforced by the supervisory personnel. This is only possible if water is of a high quality and easily accessible.

Buildings

They should be arranged practically, so as to minimize movements from one room to another, with the attendant waste of time.

Local weather should be taken into consideration in their conception. The rooms should be designed according to the work to be done in them. Some will be specially protected

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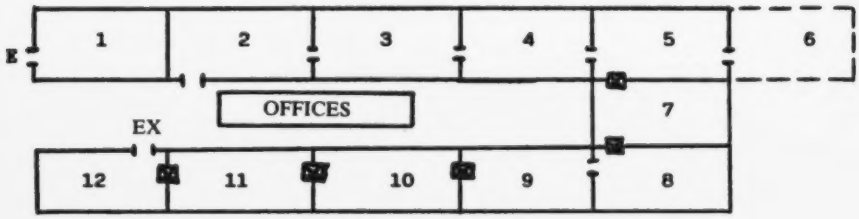
(1) Antinutritional factors are substances present in varying amounts in a food, and which interfere with the body's digesting or metabolizing of other nutrients, or which make a product harmful. These include antitrypsin factors, which inhibit the action of trypsin, an enzyme involved in the digestion of proteins; the phytohaemagglutinins, which agglutinate the red blood corpuscles "in vitro", and would therefore reduce food digestibility "in vivo"; aflatoxin, contained in groundnuts, is produced by a parasitic fungus, and is believed to play a role in primary liver cancer. Most of these antinutritional factors, occur essentially in legumes and may be destroyed by heat.

against rodents and insects (for the storage of produce and of the final product). Others should be very well ventilated, or be open sheds, for washing, solar drying and traditional toasting, for instance. The logic of production should govern each room's communication with the outdoors. Some need not look outdoors at all. An attempt should be made to reduce nuisances caused by noisy machines (grinding mills, crushers), smoke or fine particles of flour in the air. The location of the offices among the processing rooms facilitates constant supervision of the various operations. Figure 5 illustrates one possible design for buildings.

FIGURE 5

Building layout of a weaning food processing workshop



E = ENTRANCE EX = EXIT X AIRLOCK

1. Grain storage - Warehouse - Storage
2. Sorting
3. Washing. Sloping planes for water run-off
4. Solar drying
5. Electric toasting + Cooling
6. Traditional toasting (oven)
7. Crushing - Grinding
8. Storage of the flour mixture
9. Storage of the additives (milk, sugar, flavouring)
10. Mixer
11. Storage of bags and labels, Weighing - Packaging - Packing
12. Storage of the finished product

The supply of raw materials

This constitutes a major part of the workshop's regular expenditures. Competition between wholesalers or producers should be used to obtain the lowest possible rates for high quality, regularly supplied products.

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(1) Taken from: J.L. CARROIS, Projet: aliments pour bébés à base de céréales. République du Burundi, Agence de coopération culturelle et technique, 1986 - 60 p.

The price of some foods varies seasonally. Purchases may be made, when possible, at a time when supply is great and prices consequently low. However, this requires storage conditions which do not deteriorate the food product. Use of non-toxic insecticides and anti-fungic products may be envisioned.

Production tools

Their choice should take into account initial cost, quality and sturdiness, maintenance problems (particularly linked with the purchase of spare parts), and the possible application of appropriate technology. It should aim at lowering running costs (energy and maintenance).

The steps of the process at which production may be blocked should be analysed. This means that the hourly or daily output of each operation must be known. If, for example, a grinding mill can grind 300 kg/day and the toasting operation only produces 150 kg/day, the two outputs must be harmonized.

Tools which do not overheat the food, or maintain heat for too long should be chosen, so as to avoid the resulting nutritional losses in the final product.

C. Distribution

The distribution network should be organized so that families wishing to buy the weaning food will find it constantly available near their home or workplace.

Often it is preferable for the product to be sold through the usual local food network; that is, the stands, shops and markets that generally supply families, so as to reinforce the image of an ordinary food for children. It may be sold in health centres, as wel, so as to accentuate the fact that it is healthful, while providing complete information on how to use it, and advancing nutrition education. It should not be given away in these units, except for some very special cases (such as the rehabilitation of severely undernourished children from very poor homes), since heavy subsidies are then required, and there are no guarantees for future production. Gifts also tend to accredit the notion that the weaning food is a medication for sick or undernourished children, whereas it should be seen as one important part of the diet of all children during weaning.

Like all the other links in the food chain of a weaning food, the cost of distribution should be as low as possible. As study should therefore be made of the cost increment per packet represented by the management of this operation by a specialized enterprise, as compared with distribution through the workshop's own network. Evaluation should analyse the cost/efficiency balance.

The sales area surrounding the workshop should be studied in order to determine with precision, in case of a strong demand located at some distance, whether the additional costs and difficulties in supplying sellers regularly justify the eventual opening of another workshop in that area instead of increasing the capacity of the existing plant.

A system for recording the remarks and complaints of shopkeepers and health workers should be set up, so that production may be adjusted to consumer needs.

A highly flexible distribution should be sought, so that day-to-day delivery to supply points corresponds to storage capacities and to the seller's ability to pay. When a seller is temporarily in difficulty, an attempt should be made to find an acceptable solution so that users will not be affected.

D. Promotion and information

The decision to produce a weaning food is made in response to the need to improve children's diet during the weaning period. People should therefore be introduced to the weaning food, using various appropriate communication techniques. The information furnished should be complete and objective; that is, it should correspond to the role that this food may really play in the child's diet and should not praise it excessively.

All available means of information should be used. The content of the messages should be accurate, understood by families and attractively presented. This is a modern, healthful food, made for all children. It should not replace breast milk but it and other foods should constitute a complement, starting at a certain age. Children should become accustomed to different tastes and consistencies in order to develop harmoniously. Use of the weaning food should not be contradictory with a diversification of diet.

People may be informed through many channels: through direct contact between mothers and health workers during consultations, by posters showing the weaning food and demonstrations of its use located outside the health centre. The press, radio and television may report on it. Short, advertising-type messages may be broadcast, posters placed in streets or at sales points, and demonstrations made in shops and on the market-place, as well as by door-to-door prospection. It is preferable to delegate responsibility for the conception of these campaigns to professionals, who may find original ways of publicizing the product within the specific context of its production area.

Ample proof exists that changes in dietary habits originate in the most provileged classes of a population. It is just as important to convince this public to buy a cheap weaning food whose price makes it accessible to the great majority of people, as to persuade the poorest families, which harbour the majority of the undernourished children.

Packaging, be it in a bag or a box, is most important for the promotion and information process. A proper appearance gives the product a modern, attractive image. Sturdiness avoids losses during transportation and storage in homes and shops. The package should also display a picture or photo of a child aged 6 to 24 months, and indicate the place of production, expiry date, nutritive value and instructions for use.

Health workers are in the best position to recommend the weaning food to families. They should be given complete, specific information so as to be quite familiar with its qualities, how to prepare it, etc., and able to provide full advice. Perhaps students of medicine, nursing and social work should be shown about the workshop. Furthermore, attractive pamphlets may be produced specifically for them.

E. Consumption

Some families may find it difficult to use the weaning food correctly, despite the information they have received. It may be useful to set up a system for the evaluation of home preparation, storage and eating, in order to understand what is wrong and what may be done to correct these errors and to avoid any possible, harmful effects on health.

- Do people like the texture, odour, colour and taste of the food?
- Is the water/food proportion respected in diluting it?
- Is cooking time respected?
- Are sufficient amounts eaten?

- What other foods are given?
- Who eats it?
- How are the packets (or boxes) of weaning food stored once open, and for how long?
- Once the porridge is prepared, how long is it kept, and under what conditions?
- Do families establish a correlation between children's eating the weaning food and having diarrhoea?
- Is it given regularly or at certain times, and why?
- What difficulties are encountered in using it?

Comparative longitudinal surveys of child growth with or without this weaning food should be performed under medical control in one or several health centres, so as to achieve a better understanding of the impact of the intake of this food on the health and nutritional status of children. Such surveys should be context-specific. Positive findings will be a major additional argument in publicizing the product.

F. Management and financial evaluation

Strict administrative and financial management is essential to the success of such a project. A competent, experienced person should be put in charge. The fundamental role of this part of the work can never be overemphasized.

The administrative and financial staff has the following tasks:

- management of the workshop personnel;
- supervision of the stocks and their turnover, the ongoing analysis of market and distribution trends. More specifically, these people must decide when to buy raw materials, from whom and in what amounts, who to call upon to solve a given technical problem, and at what point of time, who to call upon to check on the quality of the weaning food, how to adjust production to demand, how to improve distribution.
- strict, efficient book-keeping attributing expenses to different headings, making sure that payments come in and that wages are paid regularly, analysis of financial problems and seeking of solutions, annual balance sheets, establishment of budget estimates, possibilities of investment.
- building and tool maintenance, with the participation of the workers and foreman.

A detailed book-keeping analysis must be made by specialists in order to determine the selling price of the product. It should take into account the various expenses planned and the period of amortization of equipment, predict the probable evolution of the amount of weaning food produced and of the various recurrent expenses. This is a commercial product. Its retail price should be calculated so as to enable the workshop to function and put out a regular production. The following list will give some idea of the main items of expenditure:

Buildings:	- buying the land - construction
Equipment for workshop and offices:	- driers - ovens - scales - grinding mill, crusher - mixer - packaging machine - labelling machine - storage cabinets - desks - chairs - shelves, etc. - small furnishings - vehicle
Raw materials (Including reserves)	- bags or boxes - grain (depending on the ingredients of the product) - other foods or additives
Industrial expenses	- water - electricity - other fuels (wood, oil, etc.)
Salaries	- administrative personnel - technical personnel
Sundry expenses	- vehicle insurance - fuel - office supplies (typewriters, paper, pens, etc.) - postal, telephone - bank - interest on loans - promotion, advertising - quality control
Maintenance	
Unforeseen expenses	

II. WEANING FOODS FROM THE OUANDO GARDENING AND NUTRITION CENTRE

(People's Republic of Benin)

By Martine FRANÇOIS (1), Michel CHAULIAC (2) and Roland TREILLON (3)

INTRODUCTION

A workshop producing weaning food was set up in Benin in 1977 at the Ouando Gardening and Nutrition Centre, in the vicinity of Porto Novo.

In addition to its productive activities, this centre organizes agricultural popular education sessions, participates in local nutrition education through women's action in villages, a school for mothers, a boarding home for undernourished children and the centre's Mother and Child Health programme. It distributes seeds for legumes and fruit trees and one-day-old chicks. Practical training is offered for organizers, supervisory personnel, midwives and social workers during their studies.

In addition to weaning foods, the workshop produces crackers made of soya and toasted soya flour, which are used by women to enrich sauces.

Two types of weaning food are produced: food n° 1 for 3 to 6 month-old children, and food n° 2 for children over 6 months old. They are suitable both for the nutritional rehabilitation of malnourished children (performed in hospitals) and for the prevention of malnutrition in the overall child population of weaning age.

1. INGREDIENTS

Ingredients of foods n° 1 and 2

RAW MATERIALS	FOOD N° 1	FOOD N° 2
Maize	37%	33%
Sorghum	37%	33%
Rice	15%	–
Soya	–	23%
Sugar	11%	11%

(1) Engineer - Groupe de Recherche et d'Echanges Technologiques.
(2) Physician - Teaching department, ICC.
(3) Lecturer, Ecole Nationale Supérieure des Industries Agro-Alimentaires.

Rice is included in the first baby food to avoid digestive problems. Both foods require cooking. The 20 to 30 minute cooking time must be respected, for easy digestion. Since cooking time may be difficult to estimate, and depends on how intense the heat is, a strict time recommendation is sometimes replaced by the advice that the porridge be cooked until the foam seen at the beginning of cooking has disappeared.

When production was begun, niebe beans and groundnuts were used instead of soya in food n° 2, but both were later discontinued, owing to difficulties in storing the niebe beans (rapidly deteriorated by weevils) and to the development of aflatoxins in the groundnuts, affected by aspergillus flavus, despite careful hand sorting. Furthermore, soya beans were increasingly being grown in the area, through a concerted policy effort, and a regular suply was therefore ensured.

2. FUNCTIONING OF THE WORKSHOP

The following table summarizes the main features of supplies of each of the basic ingredients.

Table 2: Supplies of raw materials at the Ouando weaning food processing workshop

Raw materials	Sorghum	Maize	Soya	Rice-Sugar	Packaging
Amts/yr (base 1984)	45 t	45 t	20 t	5.6 t (rice)	200,000 bags
Purchasing price (in FCFA: 100 F CFA = 2 FF approx. 0.35 $ US	140-150 F/kg	60-100 F/kg	300 F (84) closer to 200 F in 1985	140-150 F/kg rice 140-200 F/kg sugar	9-10 F/bag
Place of purchase	3 wholesalers in Porto-Novo	• wholesaler (normal period) • state farms (pre-harvest)		Wholesaler in Cotonou	Nigeria
Periodicity of purchases	monthly	monthly (except pre-harvest. Storage for 3 months)	variable	monthly	variable
Place of origin	South Central and Northern Benin	South Benin	South and Central Benin	Imported Thailand, Pakistan	Imported Nigeria
Shipment	by the wholesalers	by the wholesalers or the workshop (pre-harvest period)		by the workshop	by the workshop

The supply of cereals, soya and sugar is stable, since the amounts required do not exceed the possibilities of wholesalers. The latter are eager to do business with Ouando since payments are made more promptly than by other buyers (1 to 2 weeks).

The only problem is the purchasing of bags in Nigeria, since smuggling and other illicit trading led to the closing of the Benin-Nigeria border in 1984.

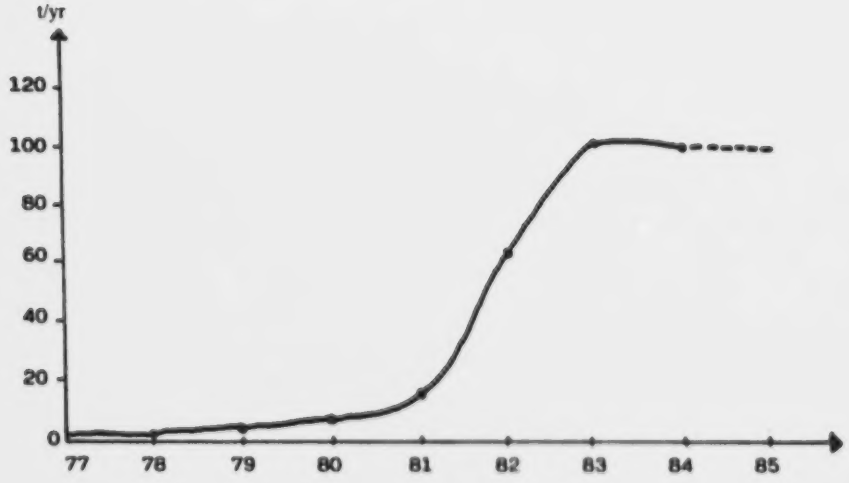
Processing

At first, the cereals were sorted by hand, dried in the sun only and toasted on traditional screens. The mixture was taken to the local mill to be ground, then returned to be packaged at the workshop.

The workshop equipment was gradually modernized and production was increased substantially. Investments were not financed by the workshop itself (except for the purchase of a van in 1982).

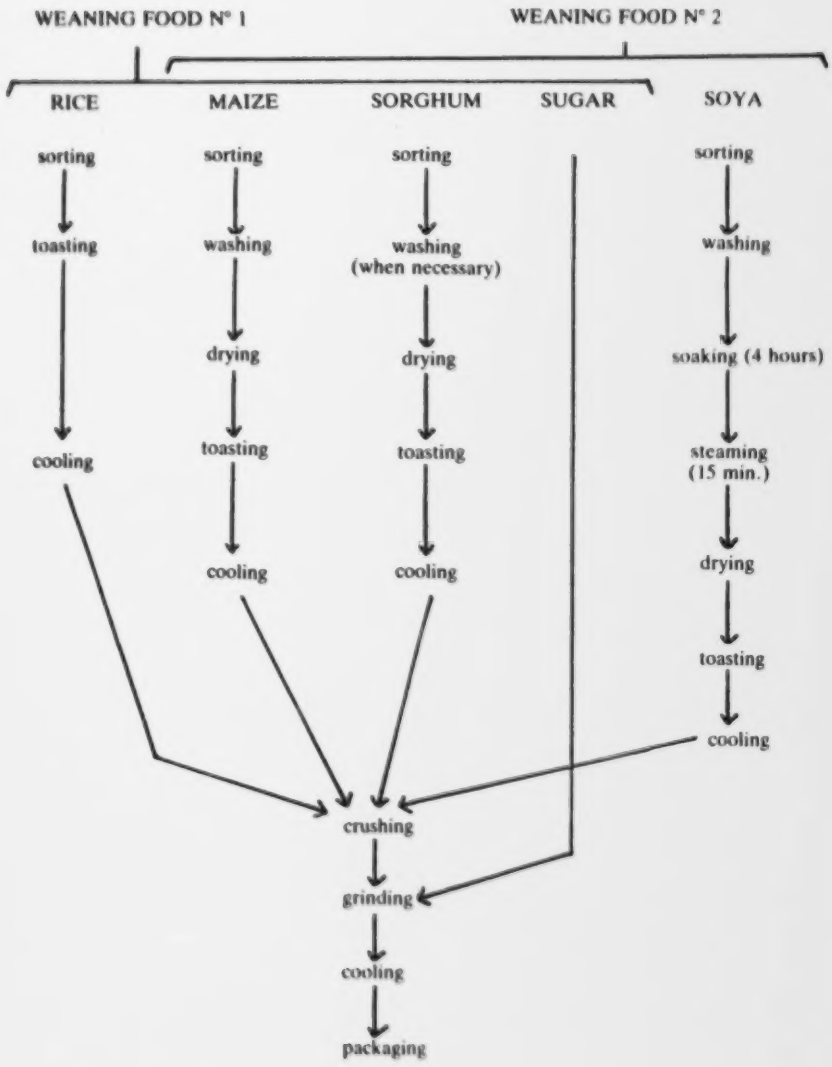
FIGURE 6

The evolution of production



The different steps in processing are presented in figure 7.

FIGURE 7



Sorting is done by hand, using traditional winnowing-baskets. Washing is also done by hand. The cereals are dried in the open air, on table-like structures with very fine nylon meshing. Drying takes 3 to 8 hours, depending on the weather. Electric driers are often used for the soya. The latter is steam cooked, following 4 hours of soaking; this eliminates the antinutritional factors. Toasting is done both in ventilated electric ovens and in improved traditional hearths. Metal tubs with holes pierced in the bottom are used for cooling. A hammer mill does the crushing; the product of this is stone ground in a grinding mill 2 or 3 times. The result is a sufficiently fine flour. This flour is then cooled in covered pans. Following weighing on a letter-balance, the 500 g packets are heat-sealed.

The main technical problems involve:

- the drying of soya: fermentation occasionally occurs during the rainy season, and the entire batch must then be discarded.
- the grinding of the cereals, which is slow, since it must be repeated three times. This is a source of contamination and is laborious for workers. Furthermore, the flour is quite hot when it comes out of the mill; this reduces its nutritive value and digestibility. A more efficient hammer mill has been purchased in order to improve this operation.
- the maintenance and repair of equipment, owing to the lack of a technician specifically trained in the technology of these machines, and to the lack of spare parts.
- the building layout is a source of wasted time and needless transportation (see figure 8). The buildings used had been designed for a different purpose before production was begun, within the periphery of the OGNC.

While it is preferable to maintain separate quarters, at some distance from the rest of the workshop, for the toasting operation on traditional screens, which generates smoke, and grinding (a noisy, dust-producing operation), the distribution of the other rooms might be modified in order to reduce transportation.

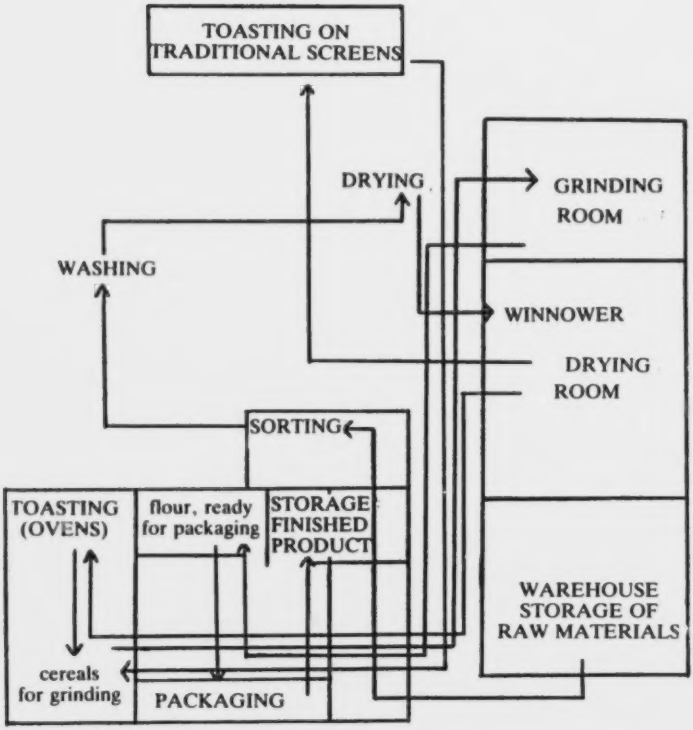
Organization of work:

Some forty-odd people are employed in the workshop, as follows:

Management	4 people	• workshop manager • production manager • two foremen • one cashier and book-keeper
Storage	1 person	• one warehouseman
Sorting	2 × 6 people	• 2 teams of 6 women
Toasting	6 people	• 3 women for electric toasting • 3 women for traditional toasting
Grinding	5 people	• 2 millers • 3 women
Packaging	2 × 5 people	• 2 teams of 5 women
Delivery	1 person	• 1 delivery man (sometimes helped by unskilled workers)

FIGURE 8

Transportation of goods during processing



Other people belonging to the OGNC work parttime at the workshop: the general manager, technical director and financial director. The centre's mechanic and several unskilled aides also contribute occasionally to the running of the workshop. Only the miller, the delivery man and the warehouse keeper have set tasks. The rest of the workers may change jobs: when necessary, the women who are doing packaging may do sorting, etc.

Personnel motivation is a major element in the success of the workshop: the women are eager to produce a high-quality weaning food, the managerial personnel is motivated, as is the delivery man, who is also in charge of publicizing the product.

The bacteriological quality of the finished product is a constant concern, and many sanitation measures are enforced in view of this. Workers wear protective over-garments, ladles are used for handling the flour, the pans in which the ingredients await the transformation operations are covered, the rooms are swept once or twice a day, the mills are cleaned daily and all of the equipment is cleaned once a week. Despite this, the acceptable germ limits have been found to be exceded in several samples (none of the most pathogenic germs such as clostridium perfringens, staphylococcus aureus or Salmonella were present, however).

3. THE DISTRIBUTION CIRCUIT

At first Ouando weaning foods were only distributed through health units (hospitals or health centres). The distribution network was gradually extended, and they are now sold in groceries and specific stands as well, or through home salespeople (mostly paramedical workers) and at markets.

The health structures, recommend these weaning foods and furnish explanations for their use. Once a mother has begun to use them, she may buy them from the dealer closest to her home.

The foods are mostly sold in the country's two largest cities, Cotonou and Porto Novo, located respectively 50 and 10 km from the workshop, whose van does most of the distribution. In both cites, the delivery man visits all sales points twice a week, to deposit the number of packets requested. The retail dealer pays for the packets (180 and 200 FCFA respectively for N^{os} 1 and 2) at the next delivery, and need therefore not advance any money. This highly flexible system enables dealers to adjust their reserves to demand, and avoids long periods of storage, which are detrimental to the quality of the product. Similarly, the workshop may adjust production to demand, which tends to decrease at the end of the month. The delivery man may also keep the managers informed of the opinions of dealers and families.

Sales in outlying areas are more complicated: the delivery man cannot come by as often, and dealers have difficulty in adjusting their stock to demand. They may find themselves out of stock, which tends to discourage consumers.

4. PROMOTION

The weaning foods seem to receive insufficient promotion present, both in rural areas where they are not distributed, and in urban areas, where many mothers have never heard of it. Two types of publicizing activities are currently practiced.

Advertising is done by the delivery man, with his van decorated with the Ouando baby, and equipped to make announcements. Many dealers have posted signs in front of their shops, to inform people that they sell Ouando weaning foods. On the other hand, radio and television have not yet been used.

As a rule, the medical and paramedical personnel of health centres takes charge of informing people. They should be capable of furnishing women with all necessary information for the proper use of these foods.

An investigation has brought several points to light. Those doctors, nurses and midwives who are familiar with the Ouando products have used them for their own children and are quite satisfied with them. Many others have never heard of these weaning foods, however. Furthermore, it seems that mothers receive extremely variable advice: some people recommend that they be used systematically during weaning, while others reserve its use for cases of malnutrition. Owing probably to an insufficient understanding of the nutritive value of the product, many omitted to mention the need to complete the child's diet with other foods. Much therefore remains to be done to inform this type of personnel, who are in the best position to guide child-feeding practices.

5. ECONOMIC ASPECTS

Retail prices

Prices vary slightly with sales points: 200 to 250 FCFA for food n° 1 and 225 to 250 FCFA for food n° 2. The official minimum wage is 12,000 FCFA per month. A comparison of the various types of weaning foods found on the market in Benin (see table 3) shows the Ouando products to be located in the middle price range, between the traditional porridges and the imported foods. This is corroborated by the type of customers: 85% of those who buy the Ouando products belong to the middle classes (craftspeople, merchants, civil servants). Farmers are handicapped in two respects: by the lack of points of sale in rural areas and the high cost for families which generally grow maize and feed it to their children.

Table 3

Comparison of the weaning foods found in Benin

	Maize porridge	Flour mixtures	Ouando products	Gallia, Blédine Phosphatine...	Cerelac Product
Place of purchase	prepared by mothers or bought from saleswoman	prepared by mothers	bought at MCH and health centres	pharmacy, supermarket	pharmacy, grocery, market
Preparation	requires cooking or ready for use if bought from saleswoman	requires cooking	requires cooking	instant	instant
Price (FCFA)	maize 80 F/kg (depends on the season)	about 170 F/kg (depends on the season, the recipe, etc.)	400 F/kg	2,000 F/kg	1,500 F/kg

Cost of production.

TABLE 4

Table 4: Breakdown of production costs for Ouando products (by %)

	Food N° 1	Food N° 2
Raw materials	45.6%	51.7%
Energy-water	15.9%	14.1%
Packaging	5.9%	5.2%
Wages	18.2%	16.1%
Equipment and buildings	8.4%	7.4%
Distribution	3.8%	3.3%
Miscellaneous	2.2%	1.9%
TOTAL	100%	100%

The cost of producing food n° 1 is 188.06 FCFA and for food n° 2, 211.85 FCFA: this is slightly higher than the price at which they are sold to dealers. At present, the Benin government pays the salaries of the workshop managers (but not those of the workers), and gives subsidies for the water and electricity used. This represents about 25% of the cost of a packet.

Socio-economic aspect

Table 5 summarizes calculations of the national added value accrued by Ouando weaning foods as compared to the imported infant foods (of the phosphatine type), for a same amount (100 tons) sold within one year.

Table 5: Comparison of national added value for imported foods and for Ouando products (in FCFA)

	Imported foods	Ouando products
State taxes	12,000,000	400,000
Importers' income		
Wholesalers Distributors	98,000,000	4,200,000
Farmer's income		16,900,000
Wages of Ouando employees		7,900,000
Ouando workshop (investments)		11,900,000
TOTAL	110,000,000	41,300,000

This table shows the inequality of what is at stake for society. In the case of imported foods, the benefits go to the importers, wholesalers and distributors. In the case of the local, Ouando products, 41.5% of the national added value returns to rural people, and thus participates in rural development. Furthermore, this calculation does not take the difference in price into account. Housewives who buy Ouando foods instead of imported infant foods economize a substantial sum which represents the "consumer advantage". In addition, far less currency leaves the country when local products are purchased.

6. NUTRITIVE VALUE

The nutritive value of these weaning foods, as measured in laboratories, calls for several remarks. Their energy value is similar to that of most other weaning foods produced around the world. The protein quality of food n° 1 and the calcium and bio-available iron content of both foods are insufficient, due to the nature of their ingredients. The same is true for vitamin content. These are therefore complementary foods which in themselves do not cover all of children's nutritional requirements.

Table 6: Nutritive value of Ouando weaning foods (for 100 g)

Content per 100 g	Food n° 1	Food n° 2
Proteins	8.3 g	12.4 g
PER*	0.5	1.81
Fat	2.7 g	9.7 g
Carbohydrates	80.5 g	71.2g
kJoules	1582	1762
Kcalories	372	422
Dry weight	92.7%	95.2%
Calcium	6.3 mg	27.5 mg
Magnesium	90.0 mg	139.0 mg
Sodium	3.0 mg	86.0 mg
Potassium	286 mg	649 mg
Zinc	3.2 mg	5.4 mg
Iron	11.9 mg	10.7 mg
Coefficient of iron absorption**	1.03%	0.8%

* Protein efficiency ratio
** Measured in vivo.

7. HOW FAMILIES REACT

In 1985, a survey was made of 183 mothers who bought the weaning foods, in order to determine their opinion and how they use the product. On the whole, families have a highly positive attitude towards Ouando weaning foods, which are believed to be healthful for children. Their organoleptic qualities: taste, smell, appearance and texture are appreciated by over 90%. On the other hand, nearly 30% of the mothers questioned found the packets to be insufficiently sturdy and the labelling insufficient.

Families buy an average of 6.82 packets of the food per month and per child, for a cost of 1,473 FCFA; this represents over 11% of the minimal wage in this country.

While most mothers use and prepare the products appropriately, several problems should nonetheless be mentioned:

- the two types of weaning food are confused. As a result, 35% of children receive a food inappropriate for their age. This is particularly true of children over 6 months old: 46% of them are given food n° 1.

- in nearly 83% of cases, food n° 2 is not prepared properly. That is, the proportions of water and flour in the porridge are not respected, resulting either in excessive dilution (57%) or excessive concentration (26%). Insufficient intake and diarrhoea are then to be feared.

- too many mothers do not respect the cooking time.

- while 91% of the 6 to 24 month-old children who were given the weaning foods were still breast fed, 30% of the mothers did not give their children any other food, and only 57% of them diversified their child's diet, introducing vegetables and animal products, in particular. This is necessary, however, if children's nutritional requirements are to be fulfilled and their dietary ration completed.

- 6 to 19% of the children in these families, depending on the region, were given these weaning foods before the age of 3 months. The risks involved in this type of attitude are greater than the advantages: decreased frequency of breast feedings may reduce the volume of milk secreted, while diarrhoea, detrimental to the child's nutritional status, may be induced.

If we are to reach the objective of improving the nutritional status of children during the weaning period, it is interesting and necessary to proceed with a complete analysis of the food chain of a weaning food, including all of the operations involved in obtaining raw materials, processing, distribution and use, as well as the economic implications of the product on the national and family level.

In their appearance and preparation, the Ouando weaning foods differ little from those foods generally used by families. They require cooking, and therefore limit the risk of diarrhoea caused by the poor quality of water.

They correspond mostly to the needs of city mothers, who have no time to prepare a home made weaning food. The selling price further tends to select this type of clientele.

The workshop may grow in size, as the volume of production has gradually increased thanks to further investment in equipment, stable, trustworthy distribution circuits, technical competency, a trained and motivated personnel and efficient management.

Distribution, which covers a relatively restricted area, is flexible and enables the ongoing adjustment of production to demand. While some technological aspects require further improvement, it is clear that the greatest emphasis should be placed on promoting the weaning foods, so that people may know them better and make proper use of them.

Such promotion should be aimed at all those who recommend, sell and use the products, and above all, at health workers.

An increase in production is not advisable. There would then be a risk of encountering the difficulties experienced by those weaning foods manufactured industrially in the Third World: a multiplication of production, maintenance, distribution and supply problems, increased risks of being out of stock, bureaucracy, etc. On the other hand, the Ouando experience should encourage some similar undertakings already begun in other parts of the country, so as to reach the rural areas, and to provide families there with an appropriate product corresponding to their needs and resources.

III. THE MISOLA EXPERIMENT IN BURKINA FASO

by Odile Benoit (1)

INTRODUCTION

MISOLA weaning food is produced in Burkina Faso, in the subsahelian region surrounding the city of Fada N'Gourma (15 to 20,000 inhabitants). Farming, essentially producing staple foods, is the only economic activity. Cereals (millet, sorghum, maize and rice), legumes (niébé, ground peas) and proteologinous seeds (groundnuts and soya) are grown, while market garden produce and some fruit trees have been introduced in recent years. Milk is available in small amounts, and is consumed by the cattle owners. Families raise chickens (but do not eat eggs, to encourage reproduction) as well as several pigs and goats for household consumption.

A Nutritional Rehabilitation Centre (CREN) was built in 1973 within the hospital premises, and began to train women organizers and village health agents in 1975. The conditions required for establishing the weaning food processing project at the CREN were defined and studied at meetings attended by the Mother and Child Health Service (MCH) physicians, pharmacists and organizers, in agreement with the chief provincial health officer.

The MISOLA production unit began to run in 1982 on a handicraft level, and was included in the regional programme for the development of mother and child health care (MCC) in February 1986.

A survey of dietary intake performed in 1981 by the ministry of rural development had shown a 29% energy deficit and a 2% protein deficit in adults, in comparison with the recommended intakes. Children are given a diluted form of tô, the traditional dish made of a thick millet gruel with a sauce containing vegetables, leaves, legumes and only exceptionally meat, from the age of one year on. The same survey evaluated the prevalence of protein-energy malnutrition in children.

Table 7: Percentage of children in age group with a weight/height ratio above or below 80% of the 1981 Harvard reference

age group / W/H	0-1 yr %	1-2 yr %	2-3 yr %	3-4 yr %	4-5 yr %	Average %
over 80%	71.0	66.4	93.4	97.2	87.1	83.7
under 80%	28.9	33.6	6.5	2.7	2.8	16.2

Using the weight for height ratio as an indicator, it found children under 2 to be the group most severely affected by acute malnutrition. The children's weight curves showed fialtering between ages 6 months and 3 years.

(1) Physician

The other main nutritional deficiencies in the Fada N'Gourma region are:

- iron-deficiency anaemia: 40% of children are anaemic;
- iodine deficiency: 5.5% of children under 3 and 7.5% of those aged 4 to 9 have a goiter.

The health team found that the nutrition education done by the nutritional rehabilitation centre for close to 20 years had been a relative failure: mothers do not prepare fortified porridges properly. Several hypotheses were advanced to explain this:

- the CREN is perceived as a hospital structure in which people are treated. Malnutrition is a sickness and the child has been cured by the hospital "treatment". The CREN does not play a role in training and prevention.
- when mothers return to their village, they do not explain what they did at the CREN. Perhaps they have no opportunity to share their experience with others.
- the preparation of fortified porridges involves extra work and a different type of organization for women whose work load is already very heavy.

The team therefore decided to produce a supplementation food, so that mothers could be given a simple product for their children, instead of having to prepare special meals in addition to adult type food. The idea was also to "show the value of local produce by explaining how to adapt it to the needs of small children".

1. PRODUCING MISOLA : THE EARLY PERIOD

A. Composition

The basic idea was to combine cereals and legumes and to use local resources. The original recipe for MISOLA was as follows:

- toasted millet flour (45%)
- toasted soya flour (20%)
- powdered skimmed milk (15%)
- groundnut paste (10%)
- sugar (9%)
- additives: iron, iodine and sodium chloride salts (1%)

Whence the name, MISOLA: in French, MIl, SOja, Lait, Arachide (Millet, Soya, Milk, Groundnuts).

B. Conditions and organization of production at the CREN

Two women from Burkina were put in charge of MISOLA, including the production unit, obtaining a supply of local raw materials and distribution (wholesale and retail sales).

A hut loaned by the CREN served as a storage place for the grain, the equipment and the stocks of the finished product awaiting sale. Processing was done at the CREN with the mothers who come with their children.

Millet, groundnuts and soybeans are purchased locally; their production has increased. Cane sugar, grown in Burkina, is furnished by a nationalized company, as are the plastic bags. Salt is purchased wholesale on the market. When used, the powdered milk was furnished by an international food aid-fund, since it is not produced locally and the additive

by the hospital pharmacy, since the skill of a pharmacist or assistant pharmacist was required to measure out the iron and iodine. Only the bag-sealing machine is run on electricity. Labels are made by the regional bureau of the ministry of health, which has a duplicating machine.

Production is self-financed through the sale of the packets, which covered the cost of raw materials, the normal running expenses and the wages of the two women workers (calculated each month on the basis of production: 32 FCFA per packet produced) by 1983. The investments come from various sources: some equipment is furnished by the hospital (driers and scales), a loan based on the capital of the Nutrition Centre (40,000 FCFA) equipment and financial aid (160,000 FCFA) furnished by the association Frères des Hommes. Subsidies were also used to purchase a stock of raw materials (110,000 FCFA). Special financing was planned for expanding the buildings, so as to improve sanitation during storage, and the keeping of raw materials.

In 1982-83 a production of 500 packets a month, representing 3 tons a year, was achieved.

C. Processing

Several long, difficult phases are involved in the processing of cereals and soya. These include washing, hulling or shelling, drying and toasting. At first the toasting was done at the flour stage, resulting in satisfactory asepsis immediately before packaging. This method was subsequently simplified; toasting is now done just before grinding, thus improving the nutritional quality of the product.

None of the methods used are industrial, and all may be used in rural areas. The city mill is used to grind the flour, which requires several successive millings in order to be fine enough for feeding to infants.

D. Nutritive value

The nutritive value of 100g of MISOLA has been assessed in laboratory:

Energy: 430 Kcal.
- protein: 22g
- fat: 11g
- carbohydrate: 59g
- water: 4g
- ash: 4g
- Iron: 32mg (including ammoniated iron citrate additive)

Table 8: Essential amino acid content (mg/g of protein)

Amino acids	MISOLA	Breast milk
Histidine	27	26
Isoleucine	47	46
Leucine	85	93
Lysine	54	66
Methionine + cysteine	31	42
Phenylalanine + tyrosine	85	72
Threonine	38	43
Tryptophan	11	17
Valine	56	55

The energy content of this food is high in comparison with a simple millet gruel, which furnishes 340Kcal/100g. Fat content is satisfactory. It is rich in linoleic acid (37.7 to 42g/100g of fat and linolenic acid (1.5 to 3g/100g of fat).

The sulfur-bearing amino acids, methionine + cysteine, constitute the limiting factor for this food, with a chemical index of $\frac{31 \times 100}{42} = 74\%$

Given a digestibility coefficient of 85% for this food, in view of its composition, 100g of MISOLA provide:

$22 \times \frac{85}{100} \times \frac{74}{100} = 13.9$g of high quality protein

The safe level of protein intake defined by the FAO/WHO/UNU expert committee (1) is:
1.65g/kg/day for 6 to 9 month-olds
1.5g/kg/day for 9 to 12 month-olds
1.2g/kg/day for 12 to 24 month-olds.

Breast milk, for which this food is a complement, provides 1.15g of high quality protein per 100g.

The chemical analysis of MISOLA shows it to satisfy the requirements of French law with respect to infant foods. Bacteriological analysis reveals a mould content slightly above the acceptable limit set by French law, as well as the presence of germs and larvae of a parasite of millet, an insect of the encupides family, on a sample batch made in July 1983 and stored for three months in Burkina Faso during the wet season. This does not make MISOLA unfit to eat. Simple sanitation measures and the building of more appropriate facilities would suffice to correct these defects.

E. Instructions for use

Like millet porridge, Misola porridge is made with water: the flour is mixed with the same volume of cold water, and the mixture is poured into 2 to 3 times as much boiling water and cooked for at least ten minutes. To complete vitamin intake, the addition of fruit or tomato juice is recommended. Consistency and quality are adjusted to the child's age and taste. It is recommended that porridge be given twice a day (one 500g packet for eight to ten days) as a complement to breast feeding from the age of four to six months on.

If breast milk is insufficient, MISOLA may be given from age 3 months on. In older children, one porridge a day (one packet a week), as a complement to the infant's usual diet, prevents malnutrition. MISOLA also provides a nutritional supplement for sick and convalescent people, pregnant and lactating women and growing children.

In the treatment of protein-calorie malnutrition, MISOLA provides concentrated nutrient intake for a small volume, and may constitute a dietary staple. The consistency and quantity are increased gradually until rations of 20 to 30g of flour per kg and per day are reached. This represents 85 to 130 Kcal/kg/day, 4 to 6g of protein per kg/day and 2 to 3g of fat per kg/day. In conjunction with breast milk and a carbohydrate complement (the family dish) this provides a sufficient ration.

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(1) FAO/WHO/ENU, Energy and protein requirements, Technical Report Series N° 724, WHO 1985, 206 p.

Such nutritional rehabilitation must necessarily be practiced under medical surveillance and may require treatment against infection and parasites, rehydration and vitamin and iron supplementation.

F. Distribution

MISOLA is distributed at the CREN and in the city of Fada N'Gourma (50%), in the Eastern district through health outposts (12.5%) and outside the district (37.5%), including in one private clinic in Ouagadougou (25%). When sold at the CREN or the district dispensary it costs 200 FCFA per packet, while its price in other selling places does not exceed 225 FCFA. (A box containing the same amount of instant baby food costs 500 to 700 FCFA).

In itself, the price determines which groups may purchase it. Although kept to a minimum, just sufficient for the day-to-day running of the workshop, this price is still rather high. In cities, it represents about 1% of the minimum monthly wage, but the health workers who sell MISOLA do not find its cost excessive, except for some exceptional cases. In rural areas, where it corresponds to the price of 3kg of millet, the price is too high.

The various sales agencies are supplied directly by the two women at the workshop. MISOLA seems to be practically exclusively distributed in the cities, then, and very rarely in rural areas or in local health units and state MCH centres, although 80% of the population lives in rural areas.

2. ASSESSMENT AND REMARKS ON THE EVOLUTION OF PRODUCTION

At the end of six months, the different phases of processing had been mastered, but were susceptible of improvement (the roasting and mixtures, in particular). The supply of local raw materials was satisfactory, while there were problems in procuring paper and plastics. Management of the equipment, raw materials and book-keeping, although regularly attended to, was faulty. MISOLA was well accepted and had reached the point of self-financing.

The objectives had only been partially achieved in 1984, however, since relatively few children had been reached, and most were in urban locations. Furthermore, poor harvests resulted in difficulties in procuring millet and soybeans. Some thought was given to how to improve use of MISOLA and adjust it to local realities.

The producers of MISOLA were faced with one major question: should production be increased, even if this meant that other production units be established, or should an effort be made to attain more adequate use by the target group?

The group from the Fada hospital and the various agencies involved in the project (Burkinese ministry of health and its nutrition unit, eastern district medical authorities, a group from the association "Frère des Hommes") sought ways to make the project viable and useful in the fight against malnutrition. It soon became clear that MISOLA could not be the universal solution for all forms of malnutrition.

Indeed, the massive use of this type of food for all children is neither possible (it would require industrial production and a distribution network implying financially solvent families) nor, in fact, desirable (there is a risk of developing dependency). Should the target group be urban or rural children? undernourished or at-risk children? those attending hospitals, health centres and mother and child care centres? Can women organizers use MISOLA for their nutrition education work? Isn't there a risk that it will be perceived as a finished product, more like a food aid product or an imported infant food than like a fortified traditional porridge?

Can the parents of undernourished children, "considered to be sick" pay the price of this treatment? This would not prevent other poeople from buying MISOLA or using the recipe, but would not make it an ordinary food.

A chart of the various possible future courses was established, at the instigation of the CREDES (see table 9).

Table 9

Main characteristics of different types of weaning food

Characteristics / Types of product	Composition	Processing Where	By whom?	Quality control	Distribution
"Treatment" food for the the undernourished	Local produce + powdered milk + additive	Urban health structures	Women paid on output basis	Pharmacist, + testing	Urban and rural health structures
"Health food" type for all children	Local produce + ½ milk - powdered	Health structures or small basis privc in cities	Women paid on private enterprise	Pharmacist	Health structures and food shops
	Local produce + ½ milk - powdered	Rural health structures	Women Women paid on output basis	Nurse	Local
"Typical mixture" for all children	Local produce	Urban (neighbourhood) or rural health structures	Mothers	woman organizer, health agent or nurse	Mothers
Food for "fortifying porridge" for all children	Local produce	Urban (neighbourhood) or rural health structures	Mothers	woman organizer, health agent or nurse	Mothers
	Local produce	or private initiatives in cities or in the brush	Crafts-people		Local

3. 1985-86 : MISOLA BECOMES A PART OF NUTRITION EDUCATION

A. General orientation

Following this period of reflexion, some choices were made, and MISOLA was assigned a role within the province's child health programme. This involved:

- the "reorganization" or mother and child health activities, and in particular, the inclusion of nutrition education and nutritional rehabilitation activities,
- the extension of the "MISOLA" experience, so as to make it an effective tool for nutrition education and nutritional rehabilitation.

In 1984, the composition of the flour was simplified by the elimination of the iron and iodine additives and of the powdered milk. This made production totally independent of outside suppliers. In 1985, two types of product were defined: MISOLA in packets, made for use in health centres for the rehabilitation of undernourished children following detection, and MISOLA as a nutrition education recipe, for use in demonstrations during nutrition education sessions in villages and in health units interested in the project. Both forms would be composed of the same ingredients: a flour made of 50% millet, 30% soya, 10% groundnuts and 10% sugar, salt and powdred, dried leaves, baobab flour of yeast.

In June, 1986, one year after this new formula was put into practice, a technical mission was sent to Burkina Faso to assess this evolution. An evaluation of the impact of the project is planned for June 1987.

B. Packaged MISOLA

The processing unit is now a part of the new provincial "mother and child" service, in the vicinity of the CREN. The facilities, equipped with water and electricity, include a $15m^2$ room and a $25m^2$ hangar. Another room should be freed so that the raw materials may be stored separately from the finished product.

Some old equipment has been replaced, two improved hearths and driers have been built and seem to be quite adequate. The technique for processing MISOLA has changed, tending towards simplification for the soya: the beans are toasted immediately after washing; hulling, by rubbing between two stones, is thus made easier. Following winnowing and the elimination of hulls by hand, a second washing eliminates the unhulled beans, which float on the surface. This is still a long process, and losses are great: 10kg of raw soybeans only yield 6 to 7kg of hulled, toasted soya. This may explain why mothers hesitate to use soya for fortified porridges. The millet is also toasted directly after washing and drying in the sun. Losses are not as great (10kg yield 8 to 9kg of toasted millet). The groundnuts are toasted when dry, in flat pans (10kg yield 8 to 9kg of toasted groundnuts) or in an electric crank toaster. They are then hand rubbed to remove the thin pink skin, and winnowed so that only the nuts are retained. The next phase in their processing is essential: sorting, to eliminate any nuts containing aflatoxins (spotted, flattened or unpeeled nuts, or those with holes). The women in charge of production strongly encourage women organizers and those who deliver toasted groundnuts to sort their nuts very seriously.

Table 10: Composition of MISOLA: the old and new formulas

Ingrédients (g/100 g)	new formula	old formula
toasted millet	53	45
toasted soya	24	20
toasted groundnuts	10	10
powdered milk	0	15
sugar	12	9
salt (+ or − additive)	< 1	1 (+ iron + iodine)

Nutritive value of MISOLA as produced in June 1986 (for 100g).

Energy	426 Kcal = 1783 KJ	iron 8.4mg
total carbohydrates	59.1g	calcium 115mg
protein	18.0g	sodium 270mg
fat	13.1g	aflatoxin B, 0.0006mg/Kg

The two women in charge of production receive help from the mothers of children staying at the CREN and from the CREN staff. Their role has changed; they produce fewer packets of MISOLA (300 to 350 a month instead of 500 a month during the first two years), but they now participate in the activities making MISOLA a part of Mother and Child Health Care (MCH). Unfortunately, there is still no official policy for the use of MISOLA in packet form, and it is sold only on request, whereas it was intended for use in the treatment of undernourished children only. Other health centres come to buy it, in the hopes of being able to produce their own, similar product.

C. MISOLA : a recipe for nutrition education

The new "mother and child" service in Fada enables women to obtain information and to discuss nutrition problems with others. Some prepare weaning foods at home. They also are interested in learning new recipes for porridges, sauces, etc.

The MISOLA programme plays another role in the mother and child health service: birth attendants from three health centres learned to make MISOLA at the production unit during a ten-day practical course. They meet every two months in Fada to discuss the situation. Production of this food was begun in these three centres on a very small budget, and is taught to women from the rural area. The recipe for MISOLA was converted into volumes, and the amount of groundnuts deliberately decreases, since it was feared that mothers would refuse to feed their children too much groundnut flour.

The following proportions are used there:

Raw millet	2 yorba	or	2 bowls
Raw soybeanbs	1 yorba*	or	1 bowl
Toasted groundnuts	1/4 yorba	jor	1/4 bowl
Sugar	1/2 of 1kg box	or	4 lumps
Salt	2 scant tablespoons	or	1 pinch

For teaching purpose, the birth attendants visit villages and neighbourhoods carrying their pots and some soybeans - still insufficiently grown in the area - and make MISOLA on the spot using the ingredients provided by the women. A porridge is cooked for the children present, and the women take the rest home with them. Some prepare some flour at home before the next MCH session. Women who are anxious to vary their children's porridges always welcome fortified millet porridges. The traditional birth attendants provide follow-up for the children's nutritional status, and measure arm circumference. These figures are recorded on a collective chart for all of the village children. Talks on hygiene, planned parenthood and vaccination are also given during the MCH sessions.

The Fada "mother and child" service also sends people to deliver talks in five villages located within a twenty kilometer perimeter. Birth attendants and mothers are greatly concerned with children's nutrition and apparently have no difficulty in learning the recipe. A basic MISOLA recipe has been established in order to avoid disproportions (especially the tendency to add too much sugar). The formula is the same as above, with 1/2 yorba of toasted groundnuts instead of 1/4.

The composition is then as follows:

- toasted millet 61%
- toasted soya 21%
- toasted groundnuts 12%
- sugar 6%
- salt 1%

When monkey bread is available, the women reduce the amount of sugar to 1/4 of a box. this is mainly valuable because of the added calcium and vitamins supplied. MISOLA then complies with the recommendations for a combination of all three categories of food in fortified porridges (an energy-providing food + a body-building food + a protective food).

The MISOLA project has resulted in two types of production: a hand-crafted product sold upon request and used for the treatment of malnutrition at the Fada N'Gourma hospital and a copy of that weaning food, used for nutrition education and rapidly adopted by rural mothers.

The last financial statement showed the present cost of producing a packet of MISOLA to be 125 FCFA per packet for the raw materials (millet 35 FCFA, soya 40 FCFA, groundnuts 20 FCFA, sugar 23 FCFA) and 100 FCFA for running costs (wood, milling, fuel, etc. about 25 FCFA per packet) and the replacement of minor equipment (15 to 20,000 FCFA per month). Wages are no longer paid by the production unit. The sales price may thus be kept down to 225 FCFA at most.

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* The yorba is the unit of measurement used at the local markets. It is equivalent to approximately 3 liters.

An evaluation of the MISOLA experience is planned for July 1987, in order to:

- incorporate surveys in the "mother and child" service, and establish criteria for evaluation, etc.
- organize activities for village birth attendants. These may continue after the evaluation, provided the latter participate actively in the investigation.
- improve understanding, within the "mother and child" service, of the situation and problems of village women.

This evaluation will include a nutrition survey based on the measurements of arm circumference and weight/height and age recorded at the CREN, and an analysis of the educational impact, acceptability and appreciation of the project and of its insertion in the national health plan.

The MISOLA project has revivified Mother and Child Health Services in the Fada region. Before it, traditional birth attendants were left to themselves, with no follow-up and no refresher training. Is this new upsurge the fruit of the money injected into the operation by "Frères des Hommes", or of the "revolutionary" team running the provincial services, or a combination of the two?

This question, raised by the evaluation team, shows how difficult it is to assess the value of this type of project for nutrition education and the local, hand-crafted production of a weaning food. The experience is of course positive as to its objective, which was the improvement of the diet of undernourished children - they were given real treatment - and as to the education of mothers - they learned some facts about nutrition: the quality of their child's diet was not a health concern of mothers of weanling infants before then.

The funds required for getting the project under way were limited to a strict minimum, and production soon became profitable. However, the desire to reach the most severely undernourished children, who are often from the most economically deprived families, remains incompatible with the wish to establish a commercial, self-financed production. These two objectives seem to be complementary: the small-scale weaning food production may be used for "publicizing" and educational purposes, and for sales to health centres for the prevention of malnutrition. It may be given free of charge for the treatment of malnourished children whose family is unable to pay.

Nutrition education, enhanced by the training of women organizers, is most important, and is the best preventive method for rural children. The workshop should remain small, so that it can be copied by other centres. A project of this type could never have been implemented without prior awareness, by educators and medical workers, of the health problems, and without their ability to visit villages and educate people, who must be willing to listen to them. This indicates the importance of incorporating these projects in the mother and child health programme, which should be supervised by a health centre. It also shows that the grassroots hand-made production of a weaning food does not miraculously solve the problem of malnutrition.

TECHNICAL NOTE

Hand processing of a complementary food for children, using local produce (1)

A supplementation food for undernourished children, or as a complement to breast milk.

Infants over six months old need other food as a complement to breast milk: this may be the family dish, porridge, purée, etc. For this use, it may be practical to make and store a flour, using local produce. It can be given to all children, in porridge form, and more particularly, to "treat" those with malnutrition. Nutrition education should include teaching mothers to prepare fortified porridges for their children regularly.

RAW MATERIALS AND COMPOSITION (by weight or volume)

- cereal (millet, sorghum, rice, maize or wheat...) 650g or 2 bowls
- legume (soya, beans, lentils or peas...) 350g or 1 bowl (very full)
- oil seeds (shelled groundnuts, sesame, etc.) 100g or 1/2 bowl

(N.B. oil seeds may be replaced by vegetable oil: soya, groundnut, cotton or other, using 50g or 1/4 bowl)

- monkey bread flour or dried green leaves: 25g or 1/4 bowl
- optional: sugar: 50g or 1/8 bowl

Equipment

- pans, pails or large gourds
- cooking pot
- large wooden spoon
- mortar and pestle
- a stone for crushing
- sieve

INSTRUCTIONS

Weigh or measure the cereal grains, wash them and toast them lightly in a cooking pot, stirring constantly (for about 20 minutes).

Weigh or measure the legumes, wash them, eliminate any that float. Toast them in a pot, stirring constantly. Toasting is finished when the seeds may be hulled between two fingers (about 20 minutes). Hull them by rubbing between two stones, winow to remove the hulls. For complete removal of the hulls a second washing is required, with removal of anything that floats, drying and a second winnowing.

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(1)CREDES 1986

For groundnuts, remove the shells. Sort them, and eliminate any damaged nuts (they contain aflatoxins). Toast them (for about 15 minutes, until lightly browned), peel and winnow them. Weigh or measure the required amount.

If sesame seeds are used, they should simply be washed and toasted, then the required amount measured.

Mix all above-mentioned ingredients after weighing, crush the mixture using a stone or mill.

Then add the powdered leaves or monkey bread flour, oil (when no oil seeds are used) and the ground sugar if desired. Mix well, using your hands.

Sift the flour thus obtained and store it in boxes that close well.

USE

The porridge made of this flour requires ordinary cooking with water. The usual amount is about two heaping soupspoons for one bowl of water.

CONTENT

Given losses during processing, the content is as follows, in terms of percentage of weight:

- cereals 58%
- legume 24%
- oil seed 10%
- dried leaves 3%
- sugar 5%

This formula is rich in fat (10%) and in protein (15%).

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IV. LIKUNI PHALA: THE MALAWI EXAMPLE

By A.J. ESCOUTE (1)

For several years, Malawi has been faced with a development crisis, partially resulting from the emphasis placed on increasing agricultural production, while insufficient attention was paid to rural development and the population's nutritional status. As a result, Malawi is one of the few African countries to have achieved not only a level of self-sufficiency in food production, but to export a sizeable amount of its agricultural production. Simultaneously, and in appearance rather paradoxically, it has difficulties in covering the dietary needs of much of its population.

This realization led the Ministry of Health to take a number of initiatives in the 1970's, including the establishment of a supplementation programme financed by the World Food Programme (FAO/WHO: "Malawi 525/Feeding in Public Health Centres"). The objectives of this WFP project included the promotion of Likuni Phala for children under five, pregnant women and lactating mothers suffering from malnutrition.

1. HOW LIKUNI PHALA WAS CREATED

Towards 1970, a sister from the Likuni Mission, Sister Trinitas, had the idea of preparing a weaning food made of maize, groundnut and bean flours. This mixture rapidly came to be known in Malawi as Likuni Phala (phala means "porridge" in the local tongue), and was given to children attending the Likuni hospital as well as in several health centres. The results were encouraging.

A small unit for the hand production of Likuni Phala was set up at the Likuni hospital; the new weaning food then began to be distributed in other hospitals and health centres, as well as in Malawian households, in which the product was to be tested.

The results were immediately found to be quite encouraging, although several points required improvement. In 1977 the WFP decided to replace CSM flour (Corn, Soya, Milk) by Likuni Phala, in the supplementation programme for the treatment of cases of severe malnutrition in nutritional rehabilitation centres for infants, hospitals and nutrition education services, as well as for supplementaion of pregnant and lactating women.

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(1) Physician on loan by the French government. Nutrition Unit. Ministry of Health. P.O. Box 30 377. Lilongwe 3 MALAWI.

A contract was signed with a company for the production of Likuni Phala. Distribution to communities and households was organized by the WFP and the Ministry of Health. At the same time, promotion of the product, aimed at beneficiaries and health workers, was implemented.

A number of difficulties appeared, however, once this new weaning food had been in use for some time. It could not be kept long, and often turned rancid. Furthermore, the porridge required much cooking, and in particular, much more than the traditional porridge. This fact, added to the finding that mothers did not always prepare the porridge properly, certainly contributed to the relatively poor acceptability of Likuni Phala during this early period.

In conjunction with the FAO, the government of Malawi decided to bring in a consultant. His report* made special note that the replacement of beans and groundnuts by soybeans seems to be valid, in order to increase protein intake, diminish cost and simplify production and commercialization. However, short-term difficulties in obtaining soybeans have delayed the application of this recommendation.

Likuni Phala continued to be produced both within the WFP project and in homes, nonetheless, in the form of a mixture of 80% maize flour, 10% toasted beans and 10% toasted groundnuts. Thanks to technological improvements it could be kept longer, was easier to digest and generally more acceptable.

In 1986 a private company was put in competition with the first company. One major technological innovation was the creation of a "pre-toasted" Likuni Phala, which was easier to digest and more acceptable, since the food was tastier, and also kept longer. This supplementation food was remarkably well accepted, and has greatly contributed to further promoting Likuni Phala within health centres. Unfortunately, large-scale production resulted in difficulties in obtaining a sufficient supply of beans, in particular; this led to a reconsideration of the composition of the product.

In fact, several of the consultant's recommendations were then adopted. The weaning food now under study would be made of "pre-toasted" maize flour for 85% and soya flour for 15%. The flour would be enriched with ascorbic acid and potassium iodide, which also prevent spoilage. Soya was chosen because the prospects for its use in mass production seemed to have improved, and it can be supplied more reliably than beans, which are subject to major seasonal variations, and may even be totally unavailable.

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* Promotion of locally produced weaning food (Likuni Phala), Malawi - Report prepared for the government of Malawi by the FAO, based on the work of George D. Kapsiotis, FAO Consultant, Rome 1984.

LIKUNI PHALA: SOME FIGURES

Likuni Phala in 1977

Composition :		Nutritive value per 100g
maize flour	50%	energy : 406 Kcal
bean flour	25%	protein: 16.7g (the equivalent of
groundnut flour	25%	11.7g of reference protein)

Shortcomings : taste disliked
turns rancid when stored
frequent diarrhoea in children
requires more cooking than traditional porridge

Toasting of the ingredients before grinding may correct this situation.

"Classical" Likuni Phala

Composition :		Nutritive value per 100g
maize flour	80%	energy : 392 Kcal
bean flour	10%	proteins : 12.9g (the equivalent of 9g of reference protein)

When commercially produced the ingredients are toasted first.

Soybean Likuni Phala

Composition :

maize flour	85%
soya flour	15%
ascorbic acid	15g/100Kg
potassium iodide	2,5g/100Kg

Maize and soybeans are first toasted.

The acceptability of this product is now being tested in 12 hopitals and health centres throughout the country, on 350 "mother-child" couples, as well as in homes. Periodical biological assays of stocks evaluate spoilage.

Cooking time: 15-20 minutes on an electric stove
15-40 minutes on a traditional wood-burning hearth.

Conservation : 5 to 6 months. It now is generally kept less than 3 months

Storage in 3 centres:		
	central region: Lilongwe	400 tons
	northern region: Mzuzu	250 tons
	southern region: Blantyre	500 tons

Secondary centres are being built in order to improve distribution and to avoid problems during the rainy season.

Distribution: by the WFP, free of charge within health centres and hospitals with storage facilities.

Beneficiaries:

- children under 5 whose weight is below the "road to health", having lost weight or whose weight has been stationary for 2 months or more and who suffer from marasmus or kwashiorkor.
- anaemic mothers and children
- pregnant women with insufficient weight gain
- twin pregnancies.

Total for 1987 and 1988: 44,000 children and 14,000 mothers.

This weaning food is marketed in plastic bags containing 50kg, wrapped in a synthetic textile.

Production: 2,250 tons in 1986 and 1987. Plans: 3,000 tons in 1988 and 1989.

Phalallac

A weaning food known as Phalallac may be found in local shops; its content is the same as Soybean Likuni Phala except for: ascorbic acid, 1.5mg/100g and potassium iodide, 0.7mg/100g.

Packaging: printed paper.

Cost: 0.98 Kwacha per packet (7 times less than products imported from Europe).

Bought by: civil servants, managerial classes, mostly in urban areas.

Nutrition education: promotion of Likuni Phala is accompanied by advice on nutrition: how to feed children, breast-feeding, how to use the weaning food, spacing of meals, cooking, home preparation of the flour.

2. THE FUTURE OF LIKUNI PHALA

Although already highly successful, this product is susceptible of further improvement. Several points should be considered.

The present version of the product keeps well, owing to the introduction of ascorbic acid (L-ascorbyl palmitate). Other anti-spoilage agents may be included if needed, provided they conform to the requirements of the FAO Codex Alimentarius Commission with respect to food additives.

The WFP conducts active testing for contaminants, in Malawi, through frequent analysis of sample batches, under the control of the Ministry of Health.

Enrichment of Likuni Phala presently takes the form of the addition of potassium iodide and ascorbic acid. Enrichment with iron and vitamin A is a possibility in the near future. Such initiatives should be encouraged; they provide a valuable contribution to primary health care and the prevention of dietary deficiencies, in which direction Malawi is now firmly engaged. It seems preferable that they be coordinated with surveys of the nutritional status of the target groups.

The nutritionally induced ailments most frequently encountered in Malawi include protein-energy malnutrition, iron-deficient nutritional anaemia, vitamin A deficiencies and iodine deficiencies. But few studies have been made of these imbulances, which are in fact basic to the country's general health context. Nutrition research is needed in this field, in order to determine practical applications within supplementation programmes, as well as national policies for agriculture, food and nutrition.

More generally speaking, Likuni Phala may be seen as a good example of an industrially produced weaning food that has been successfully introduced throughout the country. This is largely due to 10 years of action by the World Food Programme, the Ministry of Health and all those who contributed to the promotion of the product during this period. Another facilitating factor resided certainly in the fact that this product closely resembles locally prepared dishes, while its name reminds users that Likuni Phala is made in Malawi.

The ingredients - maize, groundnuts, legumes and soon soybeans - are all grown exclusively in Malawi, thus providing an outlet for local crops and avoiding recourse to imports. The WFP finances processing and storage until the product reaches the regional centres. The Ministry of Health is the WFP's partner at the government level, and is in charge of implementation of the project.

Supplementation foods, of which Likuni Phala is the most widely used, are distributed in 24 district hospitals, 25 nutritional rehabilitation centres and approximately 600 health centres; that is, practically all of the public and private health structures in Malawi. The personnel of the Ministry of Health and the primary health care agents, as well as rural workers, are responsible for distributing rations, promoting the product and dispensing nutrition education, aimed not only at home production of nutritious food, but also at teaching families how to make better use of local produce, thus ensuring the prolongation of the current supplementation project.

Transportation and distribution are financed by the government. The WFP, in conjunction with the Ministry of Health, supervises the regularity of the operations and checks on the effectiveness of the programme at each level.

The same product is available commercially and may be bought under the name of "Phalallac" by mothers who can afford it. This is a recent development, and its impact is not yet accurately known.

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IN CONCLUSION

The story of Likuni Phala provides an interesting example of the possible phases of the creation, improvement and distribution, on a national scale, of a weaning and supplementation food. On the whole, Likuni Phala has been successfully promoted, the quality of the product has been gradually improved and the initial objectives practically achieved. This is not the end of the story, and it seems probable that Likuni Phal will continue its evolution in coming years, with the introduction of soybean flour and the enrichment with vitamins and trace elements, in particular.

V. LOCAL PRODUCTION OF WEANING FOODS IN AFRICA

K.V. BAILEY (1)

INTRODUCTION

Few would deny that most of the nutritional problems of African children turn around the family cooking pot and weaning practices. But from that point onwards, everything becomes controversial. Some put the accent on the protein problem, others on the energy concentration, others again on the frequency of feeding. Some consider that periodic food shortages or patterns of breastfeeding are crucial; others that infections introduced with weaning foods are the main problem; and others again, that intercurrent infections due to greater exposure to a hostile environment, are more important than all the dietary factors put together. Of course there are elements of truth in all these points of view; the relative importance of each differs greatly from place to place and from time to time; and almost no studies have really been done to show scientifically the relative weight and interrelationships between these factors.

So fashions come and go, when it comes to making recommendations to improve weaning practices. It is startling to find at least in subSaharan Africa,

- how few careful studies of infant feeding practices have been done - even qualitative, let alone quantitative;
- how seldom clear guidelines are available, at national and local level, on what local foods to use, and how to prepare them suitably for infants of varying age (4, 6, 9, 12 months);
- how little the available guidelines are adapted to the substantially different food availability, preferences and customs in different localities.

Weaning practices are also rapidly changing, especially in urban populations, with more and more use of manufactured products, always at higher and higher cost, but not often to the nutritional benefit of the infant. For instance along the banks of the Congo River north of Brazzaville, infants used to be offered a gruel of cassava with added soft fish; but nowadays, following new urban patterns, mothers tend to add sugar, rather than fish, to the porridge. A considerable array of commercial supplementary foods is often available, at high cost, and mostly of low nutritional value.

One has to think especially of the following aspects:

- frequency of feeding;
- energy content;
- protein content;
- contamination;
- taste and prestige;
- price.

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(1) Nutrition regional officer - WHO Regional Office for Africa.

The infant from 6 months to 2 years is the most vulnerable because of declining breastmilk production, greater nutritional requirements in relation to his size than the parents are likely to recognize, and his inability to compete with other siblings. Sometimes his ration (especially of protein foods) is even deliberately reduced, by parents who think this will keep him quiet and well behaved.

Some decades ago, the fashion was for protein-rich foods. These were produced, on commercial scale, in many Third World countries, usually with technical and/or financial support from international agencies, and subsidies from governments which could not afford them.

Even with subsidy, the prices were usually beyond the reach of the poorest of the poor. So these subsidized weaning foods became yet another way of aggravating existing inequalities, by favouring urban populations against rural, and middle-income against low-income consumers. The "protein-rich foods" got a bad name, to the extent that now, no international agency will back or entertain such a well known loser.

1. GRASSROOTS EXPERIENCES IN AFRICA

The purpose of this article is to present a few snapshots of real experience and viable individual or community approaches. It is based not so much on theory as on observations made over the past decade, of small scale but successful solutions at local level.

To mention a few:

In Cotonou, Benin, a Social Welfare assistant got the excellent idea of grinding legumes (pulses) and cereals, in the cornmill situated near her Welfare Centre; various mixtures are made, of groundnuts, beans or soya with maize (two parts to one), or simply bean flour alone. The flour is marketed in simple plastic bags, at cost price; a range of mixtures as well as cowpea and soya flour are constantly available, so mothers can make their choice, and babies can have varied meals. It is already traditional to prepare a porridge as the first weaning food; the only change is to fortify it with more oil and protein. It is essential however to lightly toast the legume component, to improve its taste and digestibility and destroy the trypsin inhibitor. For ordinary beans the toasting time, over low heat, is 20 minutes; for soya beans, about 40 minutes, until the beans no longer taste "raw" when bitten between the teeth.

In the Region of Zinder, Niger, in the 1970's a weaning food made from cereals and legumes was produced in a flour mill; but it was not commercially viable. However in a village some 80 km distant, the same formula was taken up by the 4 local traditional birth attendants; they collected ingredients from the village mothers, prepared them, passed them through the local corn mill, and then returned them to the mothers. In another village, the corn mill was used to grind toasted groundnuts, to produce a fine paste, which is also mixed in the infant's porridge;

In Accra a retired nursing sister is making available to mothers frequenting the children's hospital, a good mixture of maize, sorghum, groundnut and beans, at modest cost. In the same unit, nutritionists are demonstrating the use of cowpea (niébé) flour, and selling small packets of it at cost price;

In rural Zaïre, efforts were made at a mission station in Kananga to grow soya and promote its use in weaning diets, but for about 10 years, without success. Then the key was discovered. The soya had to be lightly grilled, over a low fire, for 40 minutes, to remove the disagreeable strong beany taste. Once this secret was known, the mixture of 3 parts maize, one part soya, has become popular all over the country, as weaning food, and its positive impact on child growth has been proven.

In Kinshasa, soya flour has also been promoted. Soja is grown in a rural development project in Upper Zaïre, and 500 tons are toasted and then sent by barge, every month, to Kinhasa. There they are milled and sold to the public through a dozen kiosks set up specially for the purpose. At first a lot of publicity was required, through mass media and health centres, but now there is no more need. Every day mothers are queuing for the product whose value, both for infants and for family feeding, is so highly appreciated; and the price is so modest (10 Z per 900g).

In Ghana, in two rural areas, corn mills were introduced, both to relieve the women of the burden of pounding maize, and to promote local production of weaning mixtures. Maize was mixed with toasted groundnuts, or cowpeas, or mongo beans (reen gram, phaseolus aureus), 4 parts of maize to one of legume or oilseed. The mills were managed by local women's groups in conjunction with village development committees. The project is now being spread, with UNICEF help, to 15 other districts in the country where PHC is being intensified.

In Burundi, since 1984, several pilot experiences of this type are underway.

- Masoja: produced by a very active cooperative at Rugombo, Cibitoke province - from a cooperative farm of which 8 ha. are devoted to soya production.
- Somagi: produced by the cooperative of Gihanga, Bujumbura province.
- Musalac: produced by the Health Centre of Musaga, Bujumbura province.
- Caramel: produced by a private company in Bujumbura, a morte industrial scale operation.

All of these products are based on soya and cereals (maize and sorghum).

- In Muyinga, a weaning food based on cereals, soja and groundnuts is being tested, produced in a cooperative mill.
- Another 100 mills are to be installed throughout the country in rural cooperatives with the help of World Bank/UNDP/ILO/UNICEF.
- The Institut des Sciences Agronomiques (ISABU) has recently developed a methodology for protein-enrichment of manioc, by auto-fermentation (under controlled conditions) with Rhizopus oryzae. The process is like the Indonesian method for making "tempeh" from soya. The product has 14% protein, excellent biological value for chickens, and is well accepted by infants.
- Malted sorghum foods are also being tested; but since the resultant fluid is less viscous, the mothers prefer the traditional porridge.
- The first four of the above foods are marketed in plastic or paper bags. Demand far exceeds supply. The cooperative at Rugombo notes that infant feeding practices and even family feeding are being revolutionized in the area. Maize and sorghum flour as well as soya flour are becoming increasingly popular for family feeding as well as for

baby foods. They are marketed both localy and in Bujumbura. There is a clamour everywhere in the country for more mills, and cereal and legume flours.

Malawi has an excellent weaning food, Likuni phala, consisting of 50% maize, 25% groundnut, 25% beans. This mixture can be made at household level, but the problem of crushing the beans has to be solved. Presently it is mainly produced on a commercial basis, on contract for World Food Programme. The ingredients are not toasted. So far the possibility of producing this mixture in small local corn mills does not seem to have been exploited. The mixture contains more legume than necessary and is therefore also more expensive.

Groundnut paste or peanut butter can also be made on a household basis using mortar and pestle or two grinding stones. The paste is simply added to the flour, for making porridge. Where groundnuts are available this is probably the simplest good and inexpensive way to improve the weaning mixture. This practice is already quite widespread in many countries eg. Ghana, Zambia, Zimbabwe, and deserves to be more widely and vigorously promoted.

2. NUTRITIONAL BASIS

Analysis was made by the Joint FAO/WHO/OAU Regional Food and Nutrition Commission for Africa, Accra, of various possible food mixtures - see Annex 2. As a standard mixture we may take 20% groundnut, 80% maize. This mixture has a Net Dietary Protein Calories % (NDpCal %) of 7.0. For infants the required NDpCal % is 8.0 but since virtually all infants are breastfed, the resulting mixture is certainly adequate. For children 1-2 years of age this mixture is adequate even if the child is not breastfed. Mixtures with millet instead of maize, or cowpea instead of groundnut, have higher protein value. But mixtures with groundnut are generally to be preferred, because of the additional fat. Soya mixtures have higher value than any of the above.

In the past, the Protein-Advisory Group of the UN recommended higher levels of protein (not less than 15%). Considering that the more pressing need is usually for energy rather than protein, and that nearly all the children are breastfed for 12 months or more, we consider the level of 15% is unnecessarily high. In practice, inputs given mixtures such as groundnut 20%, maize 80% have responded splendidly, in terms of physical growth and appearance.

3. PRACTICAL BASIS

Choice of ingredients.

In practice our experience has been that the dominant factors are cultural and agricultural, rather than technical, in trying to find the best local formula. However economic factors do play an important role. For instance, mixtures with groundnut are generally the most tasty and most preferred; but usually also, more expensive. In practice a good compromise is to use 10% groundnut + 10% other bean. This proportion of groundnut gives a good groundnut flavour or "perfume" and provides extra energy.

It is essential in all cases to ensure that the legume/oilseed component be adequately toasted. Failure to respect this has been a cause of setback, for a number of years, in several countries.

In general and in principle it is best to use first the existing local cereals and legumes. These are likely to be well accepted and regularly available. However, a proportion of groundnut is always an asset. Bambara nuts and sesame are also tasty and rich in fat. Soya is a special case. One might think it a poor policy to introduce it in Africa. But in fact it has shown remarkable successess in many countries. For instance, it has spread not only all over Zaïre, but also in Rwanda and Burundi. Farmers appreciate it partly as a bean to be eaten fresh, but mainly because it is more adaptable to varied conditions, wet and dry, and soils (even poor ones) and it also keeps better in storage, being less prone to insect attack. Yields are also, averagely, higher than those of other beans. It may require some effort to spread knowledge of how to use and process soya. There are many other ways of processing it, eg. into "milk" and curd. But the soya flour is so easy to prepare, conserve and use, and so well appreciated in combination with maize or in any sauce, that its promotion always merits serious consideration.

Choice of technology

Although it is theoretically easy and desirable to produce a flour of this sort by hand, it is in practice quite difficult. Pounding, with pestle and mortar, takes a long time and it is difficult to get the flour very fine. Grinding between two stones is possible on a household basis, but not for bulk processing. Hand grinders are also feasible but cost around $50. This is too much for a family-item, and if used for bulk production of the flour, it is fatiguing, and the machine is not very durable. Both electrically and diesel-motor driven mills are available, of 2 types hammer-mill grinders. The latter are cheaper. The grains pass between two fluted metallic grinding discs. The former has rotating hammers; a sieve is used to allow the flour to pass when particlers are small enough.

It seems that in practice the main dificulty is in maintenance of the mill. When privately owned, they are looked after by one person, and there are few difficulties. If the mill belongs to a cooperative or other group, eg. women's group, there are liable to be problems.

A country-adaptable guideline for this approach is available on request from the WHO Regional Office, Brazzaville.

Storage

The production process should usually be pushed as far towards the periphery as possible. At the local level, production can be suitably regulated, even intermittent, so that significant amounts of packages of the weaning foods do not accumulate. Prolonged storage of mixtures containing substantial amounts of fat is not advisable. The fat becomes rancid, after a few weeks, and this provokes diarrhoea. Dried beans (without oil) can be kept for 4-6 months in sealed bags, or airtight tins, but once opened, there is danger of contamination from hands and the atmosphere. Mixtures containing oil (eg groundnut) can only be safely kept for about one month.

Labelling

The products should be suitably named (with local flavour) and the contents and composition indicated to the consumer. The degree of sophistication of the packaging and labelling depends on the educational level of the community served. At all events it should be aesthetic as well as hygienic and robust.

Corporate management

Collective entreprises often have difficulties in organization and financial management. The main interest for weaning food production is of course with the women. But their skills in corporate financial management and book-keeping may need to be specially developed through training courses for the purpose.

Education and information

The public needs to be exposed to intensive education and information programmes, at least at the outset, through:

- mass media, especially radio and television (where available);
- education in health centres;
- schools, where feasible;
- other "traditional" media such as women's, youth, religious and other local groups, local leaders (political and social), and so forth. Posters, series of flip charts, songs, video-cassettes etc. can all help. An overall guideline on young-child feeding should be available and it should indicate how to prepare the porridge, the frequency of feeding, other ingredients to be added, and the amounts to be added at different ages (4-6, 7-9, 10-12 months, and above).

The usual steps are followed in preparing the porridge. For a 4 month infant one mixes 5 heaped teaspoons of the mixture (about 60g) with a little cold water to form a paste. 1 1/2 cups of water is boiled, a pinch of salt added, and the paste is mixed in. The resulting mixture is boiled for 10-15 minutes, allowed to cool, and served. A teaspoon of oil should be added during the cooking if there is no groundnut in the mixture. These amounts will provide about 250 calories (300 calories if oil is added).

Since the infant should be introduced to a variety of weaning foods and eventually family food, he may be expected to take this type of porridge once or twice daily between 4-6 months, 2-3 times between 7-12 months, and thereafter not more than twice. However it can be varied greatly with the introduction of animal food components (milk, ground meat, soft fish, egg), green leafy vegetables, and other vegetables.

It is noteworthy also that this type of porridge is often well appreciated by, and nutritionally useful for, the whole family; in particular, school-age children, pregnant and lactating women, and the elderly. It can also serve as breakfast for everyone.

CONCLUSION

No one is supposing that locally-made weaning foods in an "easy" type of programme to develop, nor that it will solve all the nutritional problems. Many mistakes have been made in technology, financial investment and sophistication in the past, at least as regards sub-Saharan Africa, and many non-viable enterprises are still continuing with subsidies...

The existence of cornmills of one type or another in almost every country of the Region is however to us a challenge and an opportunity. It has been demonstrated in many different social settings that it is technically and administratively feasible to exploit modern milling technology cheaply, to produce low-cost weaning cereal-legume mixtures. To introduce such a project or programme and implant it in the right socio-cultural context is by no means simple. It may have to start by introducing new mills by way of demonstration and education. It is hardly feasible to think in terms of bringing a mill to every corner of every country for the purposes of producing weaning foods. On the other hand, they are steadily being installed more and more widely, as a means of reducing the workload (of pestle and mortar) in pounding cereals and cassava. It seems to be up to nutrition-minded technologists and technologicaly-minded nutritionists to exploit this trend in favour of the African weanling infant's diet. In the long run one would hope to educate mothers everywhere, at least in rural areas, to bring their own cereal/legume mix to the local corn mill and so produce her own weaning food as needed.

Some of the observations and experiences mentioned above show that there are indeed many promising but small-scale new developments, as well as achievements of as long as two decades' standing. The earlier pessimism as to the future of processed weaning foods should be dispelled by the experiences bubbling up in many countries - Benin, Burkina Faso, Burundi, Cape Verde, Congo, Ethiopia, Ghana, Kenya, Tanzania, Zaïre and probably many more. What is regrettable is that these vital experiences are often so extremely localized. They deserve to be publicized. Opportunities should particularly be set up for the sharing of such experiences through seminars among small groups of neighbouring countries, who have a common culture and similar ecological conditions. A plan for a series of such subregional consultations has been set up and we hope that donor support could be mustered for this challenging programme. Through such processes we hope to revolutionize the weaning processes in every country of the African Region, before the year 2000. Further details are available from the Nutrition unit of the WHO.

Acknowledgement

The author wishes to acknowledge the excellent efforts made by some government officers, private persons and local communities, in all of the above-mentioned countries, in the promotion of local production of low-cost weaning foods. It is their efforts which have inspired the present article, which we hope will encourage and strengthen their efforts and spread them to other parts of Africa.

ANNEX I

Joint FAO/WHO/OAU Regional Food and Nutrition Commission for Africa

List of Staple foods and Mixtures, and the calculated Nutritive Values

Staple Alone[+]	NDpCal% (approx)[*]	Amino acid limiting[**]
Cassava	1.0	Arginine
Plantain	1.5	Iso-leucine
Yam	2.5	S-c
Sweat Potatoe	3.8	S-c
Sorghum	4.6	Lysine
Maize	4.8	Lysine
Rice	4.9	Lysine
Wheat	5.7	Lysine
Cocoyam	5.8	Iso-leucine
Millet	7.0	Lysine
Mixtures[++]		
Maize 33%, Cassava 33%, Cowpea 33%	7.0	S-c
Maize 35%, Cassava 35%, Cowpea 30%	6.5	S-c
Maize 45%, Cassava 45%, Cowpea 10%	6.0	S-c
Maize 40%, Cassava 40%, Cowpea 10%, dried fish 10%	8.0	S-c
Maize 40%, Cassava 40%, Cowpea 10%, Cocoyam (taro) 10%	6.0	S-c
Maize 40%, Cassava 40%, Cowpea 20%	6.5	S-c
Maize 80%, Cowpea 20%	8.0	S-c
Maize 80%, Groundnut 20%	7.0	Lysine
Millet 80%, Cowpea 20%	9.5	Iso-leucine
Millet 90%, Cowpea 10%	8.8	Tryptophane
Sorghum 80%, Cowpea 20%	7.5	S-c
Sorghum 90%, Cowpea 10%	5.0	Lysine

[+] Taken from Legumes in Human Nutrition, FAO Nutritional Studies No. 19, FAO Rome, 1964 - (Table 8).

[*] The Net Dietary Protein Calories percent (NDpCal%) required is approximately 8 for infants and adolescents; 7 for children aged 1-2; 6 for children of 3-4 years; and 5 for adults. The NDpCal% for human breast milk is 8.7.

[++] The values for mixtures are calculated from FAO Tables of Amino Acid Content of Foods.

[**] S-c: Sulphur - containing amino acids (cystine + methionine).

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PRIZE NATHALIE MASSE

In 1976, to keep Dr. Nathalie MASSE's (1), memory alive, a Memorial was created. Out of the funds collected, every year the Nathalie Masse Memorial Committee award an international prize in recognition of a significant work in the field of childhood. Thanks to the generosity of the "ICC friends Association", the amount of this prize in presently set at 50,000F.

This prize, called "International Nathalie Masse Prize/International Children's Centre", aims at rewarding a candidate, who must be under 50 years of age, and who has carried out, either alone or leading a team, a work for deprived children, preferably in a developing country, whatever the field of his activities may be.

Applications must be addressed directly to the Memorial Secretariat, either through an international organization (WHO, UNICEF...), or an official of the ICC (member of the Executive Board, the Scientific Committee, head of department).

Candidates'files (2) must be prepared in three copies, either in French, English or Spanish, they should include:

- the name, date and place of birth, address of the candidate;
- a summary of the candidate's qualifications and works;
- a report outlining activities carried out for deprived children.

Candidates'applications should reach the Memorial Committee Secretariat by the 1st of December, 1987.

A jury, composed of responsibles of ICC and Memorial Committee, will elect the laureate.

The candidate must formally commit himself (herself) to come to Paris on the date fixed for the awarding of the prize which will be held in the presence of the governors and personnel of ICC, the donors, the members of the Memorial Committee, the specialized press as well as diplomatic representatives of the prize-winner's country.

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(1) Dr Nathalie MASSE, who died in 1975, was in charge of the training activities of the International Children's Centre for 18 years. She made an invaluable contribution in improving the condition of children in the world.
(2) Candidates may obtain forms from the Memorial Secretariat.

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